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Biological Indicator of Summational Exposures to Lead

Tooth Lead in Children Living in Cleveland and its Suburbs

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16. ABSTRACT

An epidemiologic study of the distribution of lead absorption in the Cleveland Metropolitan Area was carried out by analyzing the lead content of shed or extracted deciduous teeth of 11,241 children. Mean amounts of lead in teeth of children living in some suburbs were as high as those for children living within the city of Cleveland. Levels of lead in teeth declined with increasing age at tooth loss. Efforts were made to relate tooth lead levels to various environmental sources of lead. Also teacher evaluations of children's school performance and behavior were assessed in regard to tooth lead level and environmental exposure.

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BIOLOGICAL INDICATOR OF SUMMATIONAL EXPOSURES TO LEAD

Tooth Lead in Children Living in Cleveland and Its Suburbs

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DISCLAIMER

This report has been reviewed by the Health Effects Research Laboratory, U.S. Environmental Protection Agency, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

FOREWORD

The many benefits of our modern, developing, industrial society are accompanied by certain hazards. Careful assessment of the relative risk of existing and new man-made environmental hazards is necessary for the establishment of sound regulatory policy. These regulations serve to enhance the quality of our environment in order to promote the public health and welfare and the productive capacity of our Nation's population.

The Health Effects Research Laboratory, Research Triangle Park, conducts a coordinated environmental health research program in toxicology, epidemiology, and clinical studies using human volunteer subjects. These studies address problems in air pollution, non-ionizing radiation, environmental carcinogenesis and the toxicology of pesticides as well as other chemical pollutants. The Laboratory participates in the development and revision of air quality criteria documents on pollutants for which national ambient air quality standards exist or are proposed, provides the data for registration of new pesticides or proposed suspension of those already in use, conducts research on hazardous and toxic materials, and is primarily responsible for providing the health basis for non-ionizing radiation standards. Direct support to the regulatory function of the Agency is provided in the form of expert testimony and preparation of affidavits as well as expert advice to the Administrator to assure the adequacy of health care and surveillance of persons having suffered imminent and substantial endangerment of their health.

Lead is a toxic material which is present throughout the environment. As such it is important to know which if any people have absorbed it into their bodies. This report covers an epidemiologic study of the geographic distribution of lead absorption in the Cleveland Metropolitan area by measuring the amount of lead in the shed baby teeth of children. The study also related levels of lead in teeth to various environmental sources of lead.

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Acting Director,
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PREFACE AND ACKNOWLEDGMENTS

The Health Effects Research Laboratory of the United States Environmental Protection Agency awarded the Ohio Department of Mental Health and Mental Retardation a grant to analyze data it had accumulated on tooth lead levels in the Cleveland Metropolitan area. This study was to examine the geographical distribution of tooth lead, its environmental sources, and its behavioral effects. During the six-month period of the grant, Mrs. Ruth E. Hunter and Dr. Margaret A. Kelsall collected and organized data on race, vehicle traffic, industry, mean income, and air pollution levels.

The Ohio Department of Mental Health and Mental Retardation sponsored the research for the previous four-year period. The quantitation of lead in shed or extracted teeth of 11,241 children who attended 254 elementary schools in Cuyahoga County or who were treated at dental clinics and institutions; determination of the percent lifespan of residency; tabulations by teachers of children's school behavior in 52 schools; and other aspects of this report were done during the years the research was sponsored by the Ohio Department of Mental Health and Mental Retardation.

The cooperation of Mrs. Conella Coulter Brown and Mr. L. Barrett Smith of the Cleveland Board of Education enabled us to distribute the parent consent slips to obtain the tooth samples of children in the Cleveland Public Schools and to distribute and collect the teacher evaluation sheets. Public school systems which cooperated included the following: Cleveland Public, Parma, Williamsfield, Rocky River, Brooklyn, Brecksville, Garfield Heights, Cuyahoga Heights, Maple Heights, Euclid, Lodi, Olmstead Falls, Lakewood, and Cleveland Heights/University Heights. The County Board of Retardation also assisted in collection of tooth samples. Dr. James Fintz of the Catholic School system and Dr. E. F. Sagehorn of the Lutheran School system also cooperated in the distribution of information and collection of samples.

The progress of this research was facilitated by the cooperation of dentists in Cleveland. The Cleveland Dental Association passed a resolution supporting the work and volunteered assistance. Eugene Rosewater, D.D.S; Anthony J. Tomaro, D.D.S, of The Dental Clinic at Metropolitan General Hospital; Daniel Verne, D.D.S, of Mt. Sinai Hospital and the dental clinics at St. Lukes and Babies and Children's Hospitals cooperated by providing the samples of extracted teeth. Earl Willhoit, D.D.S., and Richard Smith, D.D.S., at Cleveland Psychiatric Institute gave us information pertaining to technique and equipment and also provided samples of extracted teeth. Howard Kessler, D.D.S., encouraged and helped us by providing a collection center for shed teeth from children in the schools of the Cleveland Public School System. Dr. David Scott of Case Western Reserve Dental School gave advice on information useful in dental research.

A number of organizations also assisted in presenting our program to parents. The Cuyahoga County PTA included a notice of the project in a newsletter to its chapters in the County. The Cleveland PTA assisted in the distribution of forms requiring the signatures of parents and the information on children. Nurses of the Cuyahoga County Board of Health informed parents of the need for lead tests.

The press, TV and radio stations, and a number of organizations assisted in presenting our program to parents. This assistance by the media provided the public with information on the value of lead analysis of the teeth and resulted in a well-distributed geographical response. The Cleveland Plain Dealer ran a full page article by Paula Slimak describing the purpose and value of the research on tooth lead. The Cleveland Press also printed articles on the value of testing baby teeth for lead. TV stations WUAB and WKBF interviewed Mrs. Hunter and gave her the opportunity to describe the purposes of the research and the value of lead analysis of teeth. Radio Station WCLV gave Mrs. Hunter air time to inform the public.

Specialized maps were required for determining the location of the schools, housing risks, vehicle traffic, the socio-economic factors and other variables. Mr. C. J. Thoren of the Maps Department of the U.S. Department of Commerce, The Cleveland City Planning Commission, Cleveland Growth Board, Regional Planning Board, Northeastern Ohio Areawide Coordinating Agency, and the Office of the Cuyahoga County Engineer were most helpful by providing large scale maps designed for the special aspects of housing, census tracts and other information.

The following individuals and hospital groups donated their services for collecting blood samples of suburban children who had elevated tooth lead: Dr. Robert Marshall of Lakewood Hospital, Mr. James Meyer and Mrs. Patricia Moore of Parma Community Hospital, and Miss Maryann Harvan, Mrs. Barbara Ryan and Mrs. Barbara Ryba of Suburban Hospital in Warrensville Heights. Dr. Gary Davidson of the Ohio Department of Health did the blood lead analysis for the suburban children who had elevated tooth lead. Dr. Jack Wilt, the Chief of Community Hygiene, did the tests for blood lead on the Cleveland children who had elevated tooth lead.

Mr. Robert King and Mr. J. S. Fordyce of the NASA Lewis Research Center provided the data on air lead, cadmium, and antimony; and Mr. George Craig of the Air Pollution Control Board gave us the data on particulate and SO_2. Without these data and their cooperation, air variables could not have been related to tooth lead. Technical information was given to us by Dr. Eleanor Berman, Cook County Hospital, Chicago, Illinois. The Ohio Environmental Pollution Agency checked our lead standards for accuracy. Computer analyses were done by Dr. Thomas Holland and Mr. Aharon Fein of the Human Resources Laboratory of Case-Western University

We especially appreciate the assistance of Mrs. Kathleen Polak for typing the tables, manuscript and other assistance in the preparation of this report.

SUMMARY

Lead in shed deciduous teeth is an indicator of the lifetime accumulated absorption of lead experienced by children in response to environmental exposures. In contrast to this, lead in blood is known to be transitory and reflects most commonly recent exposures.

The objectives of this research were analyses of lead burdens, as indicated by lead in the teeth of children living in Cleveland and some of its suburbs, in relation to geographical location, housing, vehicle traffic, mean income, industry, and air lead; and the assessment of accumulated tooth lead in relation to physical, emotional and learning disabilities of children.

The amount of lead in the teeth of 11,241 children in Cleveland and its suburbs which were located at varying radii and in all three directions from the center of Cleveland was determined by use of atomic absorption spectroscopy. Tooth samples were obtained from children enrolled in 135 elementary schools in the Cleveland public school system, 43 Catholic schools in Cleveland, 11 Lutheran schools, and 70 schools in the suburbs.

Mean amounts of lead in the teeth of children living in some suburbs were as high as those for children living within the City of Cleveland. The mean amount of lead in incisor and molar teeth of 5,333 children in the Cleveland public school system was 5.57 ± 2.05 mg Pb/100 grams of tissue. The mean tooth lead for the suburbs was 5.45 mg Pb/100 g.

The percent frequency of children who had 8.0 or more mg Pb/100 g was

approximately the same for the Cleveland and suburban children. Elevated tooth lead (8.0 or more mg Pb/100 g) was present in the teeth of 13.2% (834) of the 6,326 Cleveland children and 12.6% (460) of the 3,653 children living in the nine suburbs.

The percent occurrence of children having 8.0 or more mg Pb/100g was determined for each school. The location of schools and the % occurrence of elevated tooth lead showed the following:

1. The % occurrence of elevated tooth lead for schools did not follow a radial pattern of decrease from the center of the city to the suburbs and exurbs. Schools which had the highest frequencies of elevated tooth lead were scattered in their geographical location throughout the City of Cleveland and its suburbs.
2. The ranges in percent occurrence of elevated tooth lead varied more between schools within Cleveland and within most suburbs than between the City of Cleveland and it suburbs or between suburbs.

Shed crowns of incisor teeth which did not have a cavity or filling represented 75% of the sample of the Cleveland children and 80% of the sample of children in the suburbs. The frequency of elevated tooth lead (8.0 or more mg Pb/100 g) in shed incisor teeth which did not have a cavity or filling was 15.2% of the 3,911 children in the Cleveland public schools and 15.5% of the 2,854 children in the nine suburbs.

Molar crowns without cavities and/or fillings comprised 17.6% of the samples of children in the Cleveland public schools and 12.2% of the suburban group. The incidence of elevated lead in molar crowns without cavities and/or fillings was 4.3% for the Cleveland group; and 3.2% for the school systems in the nine suburbs.

Frequency distributions of the amounts of lead in shed incisor crowns without cavities and/or fillings for the 3,911 children in the Cleveland public schools were the following: 39% of the teeth had 0-4.9 mg Pb/100 g; 46%, 5-7.9 mg Pb; and 15.2%, 8.0 or more mg Pb/100 g. For the 2,854 children in the 70 suburban schools, the % frequency distribution of lead in shed incisor crowns without cavities and/or fillings were the following: 42% had 0-4.9 mg Pb/100g; 42%, 5-7.9 mg Pb; and 15.5% were in the range of 8.0 or more mg Pb/100 g.

The amount of lead in incisor crown tissue of shed teeth which did not have a cavity and/or filling decreased with the age at the time of tooth loss. Coefficients of correlation between the amounts of lead in shed teeth and the age at time of tooth loss were significant for each of the public and parochial school systems. Greater amounts of tooth lead in the younger children may be due to loss of less lead during a shorter period of resorption of the roots of the deciduous teeth. However, the possibility that many of the younger children were subjected to increased lead pollution during infancy and the toddler stage should also be considered.

The occurrence of elevated tooth lead (8.0 mg Pb/100 g) was highest in five-year-old boys and girls. For the 2,120 boys in the Cleveland public schools, the incidence of elevated tooth lead decreased from 27.8% in five-year-olds to 5.2% for the boys aged 9 through 12 years. The incidence of elevated tooth lead was 24.7% for five-year-old girls and decreased to 5.2% for girls aged 9 through 12.

A similar decrease of tooth lead with age occurred in boys and girls living in the suburbs. The incidence of elevated tooth lead was 26.1% for five-year-old boys and 1.4% for boys 9 through 12 years old. The incidence of elevated tooth lead was 22.2% for five-year-old girls and 2.4% for girls 9 through 12 years old.

The percent occurrence of elevated tooth lead for children in 126 of the Cleveland public schools was positively correlated with the number of industries within a one-half mile radius of schools in the Cleveland public school system. However, the percent occurrence of elevated tooth lead was not significantly correlated with any of the following: % pre-1950 houses in the census tract of the school; the % white children in the school; mean income of the census tract in which the school was located; or with the number of vehicles passing through major intersections in a one-half mile radius of the schools.

Risk of obtaining lead from household paint was estimated by using the percent of pre-1950 built houses within the census tract. As expected, the percent of pre-1950 built houses in the census tracts of the school was negatively correlated with mean income for the Cleveland public and parochial school systems. The percent of pre-1950 built houses was positively correlated with lead industries for the Cleveland public and parochial schools and also for the suburban public schools. The number of lead industries had significant negative correlations with mean income for all three groups of school systems. The percent white children in the Cleveland public schools correlated positively with mean income. However, the percent white children in the suburban school systems was not significantly correlated with mean income. The percent white children was significantly negatively correlated with the percent pre-1950 housing and with vehicle traffic.

The incidence of elevated tooth lead in Cleveland public and parochial schools was not related to air lead exposure when measured by the percent of air lead samples above 1,515 ng/m^3. Furthermore, the incidence of elevated tooth lead was not related to air particulate levels, percentage of air cadmium levels above 19.5 ng/m^3, percentage of air antimony levels above 217 ng/m^3, or percentage tests of SO_2 levels above 80 ng/m^3.

The percent age of daily air lead levels above 1,515 ng/m^3 was 10% or more for 10 to 17 Cleveland air-collecting stations. For air station #10, 60% (15 of 25) of the samples were above 1,515 ng/m^3. Air station #14 did not have any of 34 samples for air lead above 1,515 ng/m^3. Air cadmium data were obtained at the same 17 air stations where the air lead was determined. With the exception of air station #19, all air stations which had 10% or more of the samples with air lead levels above 1,515 ng/m^3 also had 10% to 24% of their samples with cadmium levels above the baseline of 19.5 ng/m^3. Antimony in amounts above 217 ng/m^3 was present in 40% and 54% of the samples from two air stations. The air lead scores of percent samples above 1,515 ng Pb/m^3 was not related to air suspended particulate, air cadmium, or SO_2; but had a significantly negative correlation with the percent of samples for air antimony above 217 ng/m^3.

Air lead was significantly correlated with the teacher evaluation scores of the physical and emotional symptoms, and the learning disabilities which may be related to lead toxicity. The significance of Pearson coefficients of correlation between the percent of air lead samples above 1,515 ng/m^3 and the scores of the teacher evaluations were the following: .028 for the seven physical symptoms; .008 for the ten emotional characteristics; and .019 for the seven learning disabilities. The Spearman correlations were also significant.

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SECTION 1

INTRODUCTION

This investigation on lead in shed deciduous teeth of children includes consideration of the period of residency, lead content of air, and evaluations by teachers of physical, emotional and learning disabilities of their students. Earlier reports on tooth lead in children were based upon very small samples of suburban children. This study included more than 7,000 children in Cleveland and 4,000 children in 11 suburbs located at varying radii and in all three directions from the City of Cleveland.

Our review of the literature indicated that the principal cause of lead poisoning in children is considered to be lead based paint and that lead poisoning was considered primarily a hazard for children living in the inner cities. In the design of this project, therefore, we selected for the collection of tooth samples elementary schools within the City of Cleveland and suburban schools located at varying radii in all three directions from the center of Cleveland. We expected to find a higher prevalence of elevated tooth lead in children living in the inner city than in those living in the suburbs. However, our observations on lead in the teeth of the first 2,500 children showed pockets of a high prevalence of elevated tooth lead in delimited areas of the suburbs.

Since this observation showed the need for investigation of the sources of lead in these "pockets" of the suburbs, we studied stationary source of emissions, mobile source emissions as well as the housing risk. The percent of lifespan that the children lived in the house where residing when the tooth was shed was determined for each child. This percent lifespan of residency enabled us to relate data on tooth lead to housing and other environmental sources of lead pollution. Data obtained from the survey of atmospheric pollutants made by NASA for air collecting stations in the City of Cleveland during August 1971 to August 1972 permitted us to relate tooth lead to atmospheric lead, cadmium, and antimony. The Cleveland Air Pollution Center gave us the data on air particulate and SO_2 from 1971-1972.

Teacher evaluations of student characteristics were used to determine possible effects of accumulated lead on children in 24 schools in Cleveland and 26 suburban elementary schools. The teacher evaluations of children's performance were rated on a tridimensional scale which included physical, emotional, and learning disabilities. After approximately half of the 11,241 samples of teeth from children living in Cleveland and in all of the suburbs were analyzed, we selected those inner city and suburban schools which had the highest prevalence of elevated tooth lead and matched these schools with nearby schools having low prevalences of elevated tooth lead but having similar socio-economic characteristics. Evaluations of children by teachers at the end of the school term is an applicable method because some of the postulated behavioral effects of lead absorption should be recognizable in the classroom.

ACCUMULATED LEAD IN TEETH

Lead in excess of the amount which can be eliminated accumulates in the bones and teeth (Brudevold and Steadman, 1956). Shed baby teeth are excellent indicators of a child's lifetime exposure to more lead than can be eliminated. Dentine and enamel in the teeth are not subjected to remodeling as is bone because teeth do not undergo calcification except in cases of injury (Strehlow and

and Kneip, 1969). In addition, shed deciduous teeth are readily and easily available samples. Tests for blood lead are useful in detecting cases of acute lead poisoning, but do not indicate chronic cases (Berman, 1966) or previous summated exposures (Needleman, Davidson, Sewell and Shapiro, 1974).

In 1962, Altshuller, Halak, Landing and Kehoe showed the value of using deciduous teeth as an index of accumulated lead. They found that the mean tooth lead was 15.9 mg Pb per 100 g. in six children who died of lead poisoning and 11.6 mg Pb per 100 g. in nine children who survived acute lead poisoning (Altshuller, Halak, Landing and Kehoe, 1962). Since 1972, shed and extracted teeth have been used to determine the amounts of accumulated lead in children in Philadelphia (Needleman, Tuncay and Shapiro, 1972); Shapiro, Dobkin, Tuncay and Needleman, 1973), Charleston (Habercam, Reigart and Croft, 1974), and Belfast Ireland (Sewart, 1974).

BEHAVIORAL EFFECTS OF LEAD ABSORPTION

Hyperactivity of children is perhaps the most difficult and prevalent problem for teachers in elementary schools. More than half of a group of hyperactive children were reported to have blood lead in the upper level of the normal range (David, Clark and Voeller, 1972). Subclinical levels of lead appear to produce short and long term effects on behavior and intelligence (Bryce-Smith, 1972). However, indirect effects of visual motor deficit also affect learning and may aggrevate hyperactivity. Werry (1968) states that visual motor deficits are probably more directly responsible for learning disorders than hyperactivity or attention deficits. Hyperactive children frequently have visual motor deficits which cause poor handwriting and interfere with school work and participation in activities in the schoolroom (Laufer, Denhoff and Solomons, 1957).

Visual motor deficits were a permanent residual effect of lead poisoning in all cases studied by Bradley and Baungartner (1958). Chelation treatments used for removal of lead may differ in improvement of visual motor function. Bradley and Baungartner (1958) found that use of EDTA produced better improvement in visual motor tests than BAL. De laBurde and Choate (1972) state that many lead-poisoned children who do not have clinical signs of encephalopathy show subtle signs of brain injury on later evaluations. Behavioral and visual-motor effects were the most frequent effects of lead poisoning and were present in many individuals who had normal intelligence (De laBurde and Choate, 1972). Bryce-Smith (1972) states that supposedly "acceptable" exposures to lead may be associated with adverse behavioral effects.

SECTION 2
METHODS

FIELD METHODOLOGY OF LEAD ABSORPTION STUDY

Sample Frame

The sample frame for collection of tooth samples was elementary schools and special institutions in Cuyahoga County of Ohio. Children in both the public and parochial elementary schools in Cleveland and in the public and parochial schools in the suburbs lived in the immediate area of their elementary schools. Response to the initial request for participation resulted in the collection of teeth from 11,241 children. Since the Department of Mental Health and Mental Retardation of Ohio advised us not to collect additional samples, follow-up of the first request was not done in order to increase the response rate.

Within the context of Cuyahoga County, children were divided into three major categories: a) Cleveland School System, b) Suburban School Systems, and c) Special Institutions. Within the City of Cleveland, the first major breakdown was the Cleveland public schools and the parochial schools. Parents of children in 135 elementary schools in the Cleveland public school system sent in the shed baby teeth of their children. Parochial schools included 42 elementary schools in the Roman Catholic school system in the City of Cleveland, and 11 Lutheran schools in Cleveland and the suburbs. Suburbs were selected to include those located at varying radii in all directions from the center of Cleveland. The total number of public elementary schools was 70 for all of the suburban school systems. Six exurban schools were also included.

Special institutions included six dental clinics, three institutions of the Ohio Department of Mental Health and Mental Retardation, and institutions for children with special disabilities. Three of the dental clinics were located on the east side of the Cuyahoga River; and three, on the west side.

Collection of Samples

Parental permission slips and envelopes for enclosing the shed tooth were distributed by school systems through classrooms of elementary schools to the parents. When the child lost a tooth, the parent signed the parental permission slip for lead analysis and supplied the information requested (name, age, sex, twin, address, number and age of siblings, birthplace, and number of years of residency at current address). Children deposited the envelopes which contained the shed tooth, signed slip, and information in collection boxes at the schools. Periodically, schools sent these envelopes to a central collection center for the school system.

DATA GATHERED FOR LEAD ABSORPTION STUDY

Information Obtained From Parents

Information on children included age and sex because preliminary analysis indicated that elevated tooth lead was present in more teeth of five-year-olds than in the teeth shed by older children. Sex is a variable in relation to maturational development and the incidence of pica. The number and age of younger siblings is a variable of socio-demographic significance. Information on younger siblings was also obtained to provide a means for follow-up blood tests for younger siblings of the children who had elevated tooth lead.

The percent lifespan of residency was determined for each child by using the age of the child and the period of residency at address where living when the tooth was shed or extracted. The period of residency of children who lived 80% to 100% of their life at an address was related to environmental factors because tooth lead represents lifetime exposure to more lead than can be eliminated. In contrast, blood lead levels fluctuate daily and hair lead levels fluctuate monthly.

Tooth Lead

Preparation and Analysis of Samples--

Each tooth was in an envelope with the consent slip signed by the parent and the information on the children. This information was recorded according to identification of the tooth, presence or absence of cavities and/or fillings, and by school system, school, and individual child.

Precautions to exclude contamination of the tooth sample by extraneous lead began by staining the plaque on the tooth. The tooth was then placed into triple distilled water containing pumice and sonic cleaned. This cleaning step was followed by hand cleaning done by using a hand dental piece and appropriate tips to eliminate debri on the surface and in crevices of the teeth. All fillings and cavities were cut or drilled out. Only tooth enamel and dentine were used for the sample.

The sample was cut and weighed, placed into a crucible which was capped and ashed in a muffle furnace below 500^{o} C to eliminate the organic components. The ash was picked up in concentrated nitric and perchloric acid. The crucible and its cap were rinsed with acid solution. The sample was wet digested for 24 hours; then diluted to a 10% solution with deionized distilled water for aspiration into the flame of the Atomic Absorption Spectrophotometer (AAS) (Harrison, Yurachek and Benson, 1969). The samples were warmed just enough in a water bath to put the supersaturated material into solution, Vortex mixed, and then aspirated into the AAS.

Quality Control Considerations--

To keep out contaminants, filters were placed on air vents of the laboratory rooms used in preparing the tooth samples. The windows were sealed. This room was used only for tooth preparations. No smoking was permitted. Teflon hand tools and diamond cutting tools were used. Since centrifuging causes loss of lead in the residue, this step was eliminated. All samples were in solution when run on the AAS. Each sample was run in duplicate and rerun if indicated.

All steps of tooth preparation (cleaning, cutting, weighing, wet ashing, and spectroscopy) were done by random sampling. Each run contained samples of boys and girls of various ages and of children enrolled in different public and private, Cleveland and suburban school systems. This random sampling was used at all steps to reduce variations of technicians and the testing procedure by distribution throughout the analysis of the total tooth sample. Fisher Standards were used. All chemicals were ACS Reagents. Nitric acid had .00001% Pb; perchloric acid had .0001% Pb. Our standards were checked by laboratories specializing in quantitative analyses of trace elements and toxic metals.

Traffic Density Score

The vehicle traffic or HWAY score represents the total number of vehicles passing through the major intersections within a one-half mile radius of a school during one 12-hour period from 7:00 AM to 7:00 PM on one of the five work days of weeks in June, July or August in the years from 1957 to 1970 inclusive.

Source of Data--

The source of data for the HWAY score was the following: "Traffic at Major Road Intersections in Order of Total Vehicles during the 12-hour Period 7:00 AM to 7:00 PM. Revised to include 1970 Counts. Published, 1971, Albert S. Porter, P.E., Cuyahoga County Engineer, 1928 Standard Building, Cleveland, Ohio 44113".

There were 31 pages in the combined report and two sets of figures. The first list consisted of 768 busiest intersections in Cuyahoga County during the period of 1968, 1969, and 1970. The second list consisted of the intersections on which vehicle counts were made during the period from 1957 to 1967 inclusive. These two lists contained 1,050 of the busiest intersections in Cleveland, its suburbs and other parts of Cuyahoga County. The number of vehicles passing through the intersections during a 12-hour period ranged from 85,596 to 200 vehicles for the 1,050 intersections.

Determination of Traffic Density Score--

All intersections in the above lists were located on maps for each of the public and parochial elementary schools included in this study. The exact number of vehicles passing through the intersections during the 12-hour period was recorded on tabs placed on the intersections. A one-half mile radius around each elementary school was the area included in determining the HWAY score. The total number of vehicles passing through all intersections within the one-half mile radius of each elementary school was determined. This number was rounded off to the nearest 100 after the total number of vehicles in the one-half mile radius was determined. This number was the HWAY score. A "0" score was given to those schools which did not contain a single intersection in the list of the 1,050 busiest intersections in Cuyahoga County.

Housing Risk Score

Source of Data--

The census tracts in which elementary schools were located were the basis for obtaining information on housing risks and mean income. The map used to identify the census tracts was the following: "Map Compiled, Published and Copyrighted by Commercial Survey Company Map Publishers and Designers, 203 Caxton Building, 812 Huron Road, Cleveland, Ohio, 44115". The source of information for housing and income was the following: "Census Tracts, Cleveland, Ohio, Standard Metropolitan Statistical Area", U.S. Bureau of the Census Population and Housing: 1970 Census Tracts. Final Report (PHC (1)-45) Cleveland, Ohio, SMSA. After elementary schools were located on the exact area of city blocks on the map showing census tracts, the census tract numbers were recorded for each school.

Determination of Housing Risk Score--

The housing risk (HRISK) score for schools was the percent of year-round constructed before 1950 for the census tract in which the schools were located. Tables H-2 "Structural, Equipment, and Financial Characteristics of Housing Units: 1970" in the PHC (1)-45 article listed above were used to determine HRISK scores.

The number under the heading "Number Year-Round Housing Units" was recorded for each school. The number of housing units built in 1939 or earlier was recorded for each school. The number of housing units built during 1940-1949 was also recorded for each school. The number of units built before 1939 was added to the number built during the period from 1940-1949. This sum was divided by the number of all-year-round housing units to determine the percent of housing constructed prior to 1950. Percent figures were rounded off to the nearest whole number; for example, 80.5% became 81%; 80.45%, 80%.

Income Score

The mean income (ECON) score was the mean annual income listed for the census tracts in which the schools were located. Tables P-4 "Income Characteristics of the Population: 1970" in the U.S. Bureau of Census Population and Housing: 1970 Census Tracts. Final Report (PHC (1)-45), Cleveland, Ohio, SMSA were used to determine the mean annual income for the census tracts.

Lead Industry Score

Source of Data--

The industry score (IND) indicates the actual number of lead industries within the one-half mile radius of the elementary schools. The source for IND scores was the following: "1972 Directory of Ohio Manufacturers" by the Bureau of Economic Research, Ohio Department of Development. 27th Edition. Volume 1.

Determination of Lead Industry Score--

Industries which use lead to process raw materials, treat products during the process of manufacture or otherwise use lead in manufacturing a product were marked. The selected industries were checked by a consultant who corrected and verified the accuracy of the use of lead in these industries. The addresses of the lead industries were marked on maps. The number of lead industries within a one-half mile radius of each of the elementary schools was the IND score.

Air Pollution Levels

Determination of Air Pollution Exposure--

Air Lead.--The air lead score was the percent occurrence of analyzed air-lead samples which were above 1,515 nanograms of lead per cubic meter of air. The baseline of 1,515 ng/m^3 was obtained by multiplying the mean of 757.8 ng/m^3 by two. The mean of 757.8 ng/m^3 was the arithmetic mean of the 16 annual geometric means for 16 air-collecting stations in Cleveland.

Air Cadmium.--The air cadmium score was the percent occurrence of analyzed air cadmium samples which were above 19.5 nanograms of cadmium per cubic meter of air. The baseline of 19.5 ng/m^3 was obtained by multiplying the mean of 3.9 by five. The mean of 3.9 ng/m^3 was the arithmetic mean of the 16 annual geometric means for the 16 air-collecting stations in Cleveland.

Air Antimony.--The air antimony score was the percent occurrence of analyzed air antimony samples which were above 217 nanograms per cubic meter of air. The baseline of 217 ng/m^3 was obtained by multiplying the mean of 43.4 ng/m^3 by five. The mean of 43.4 was the arithmetic mean of the 16 annual geometric means for the 16 air-collecting stations in Cleveland.

Air SO_2.--Data on SO_2 for air-collecting stations within Cleveland for the period of August 1971 to August 1972 were obtained from Mr. George Craig of the Air Pollution Center for the City of Cleveland. The SO_2 score was the percent occurrence of analyzed SO_2 tests which were 80 micrograms or more per cubic meter of air. The baseline of 80 $\mu g\ SO_2/m^3$ was used because this amount of SO_2 is the Federal Annual Mean Standard (Bergman, H. G. 1960. Comments on the USEPA Development of a Sulfur Dioxide Control Strategy for the State of Ohio).

Air Particulate.--The air particulate score was the percent occurrence of analyzed particulate tests which were above 125 micrograms of particulate per cubic meter of air. The baseline used was 125 $\mu g/m^3$ which is the arithmetic mean of the annual arithmetic means of the 20 air-collecting stations in Cleveland. These data were also obtained from Mr. George Craig of the Air Pollution Center of Cleveland.

FIELD METHODOLOGY FOR BEHAVIORAL STUDY

Sample Frame

After contacting the superintendents of each school system, teacher evaluation sheets (one per child) were taken to those schools which had the highest percent prevalence of children with elevated tooth lead levels and to schools having the lowest prevalence. Control schools were those which had low prevalences and were located in a nearby area with similiar socioeconomic characteristics. These schools were selected on the data collected at the time one-third of the tooth samples were analyzed.

Sample Collection

Included in the packets of the evaluation sheets was a letter to principals of the schools advising them of the project and letters for each teacher. Teachers were invited to fill out an evaluation sheet for each child in class. No name was required, just the grade book number, age and sex of the child, room number, and the name of the school. Teachers evaluated their classes at the end of the school year. The teachers did not know if their school or class had a high or low prevalence of elevated tooth lead.

Determination of Teacher Evaluation of Child Score

Teacher evaluations were scored as five separate items (left-handed, medication, physical, emotional and learning scores) for each elementary school. Physical characteristics included gait, convulsions, tremors of the hand, muscular incoordination, squinting of eyes, ambidexterous, and maturation lag. Emotional evaluations included restlessness, cries easily, aggressive behavior, impulsive, temper outbursts, emotional instability, cruel behavior, withdrawn, bangs head, and unpopular with peers. Learning characteristics included regressions in writing or drawing, reading, and speech; poor memory, difficulty in arithmetic; and short attention span.

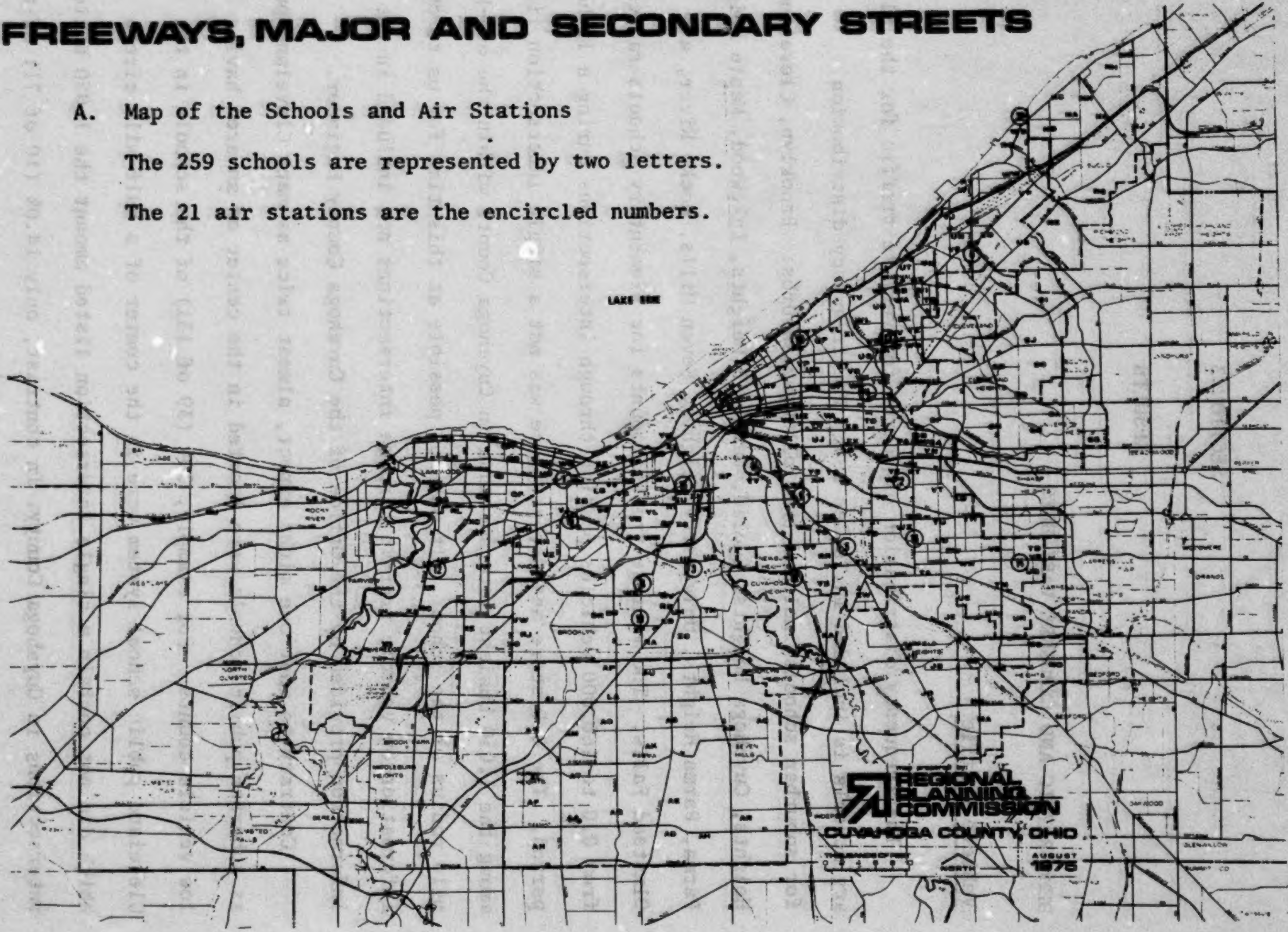
The physical evaluation score was the percent frequency of the "Yes" response for the total seven physical measurements. The emotional score was the percent frequency of the total ten emotional characteristics. The learning score was the percent frequency of the total seven learning traits.

FREEWAYS, MAJOR AND SECONDARY STREETS

A. Map of the Schools and Air Stations

The 259 schools are represented by two letters.

The 21 air stations are the encircled numbers.



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SECTION 3

RESULTS

DEMOGRAPHIC AND EXPOSURE VARIABLES

Vehicle Traffic

The frequency distribution of scores for vehicle traffic for the elementary schools is included in Tables 1-4. The frequency distribution for suburban schools included the following suburbs: Brooklyn, Cleveland Heights, Cuyahoga Heights, Euclid, Garfield Heights, Lakewood, Maple Heights, Parma, Parma Heights, University Heights, Seven Hills, Rocky River, and Olmstead Falls. The vehicle traffic counts for elementary schools ranged from 0.0 to 160,000 vehicles passing through intersections during a 12-hour period. The 0.0 score means that there was not a single intersection listed among the 1,050 busiest intersections in Cuyahoga County within the one-half mile radius of the school. It was not possible at this time for us to obtain information on vehicle traffic through intersections not included in the information provided by the Office of the Cuyahoga County Engineer.

Contrary to what one might expect, almost twice as many Cleveland public as suburban public schools were located in the center of an area having low vehicle counts. For example, 30% (39 of 131) of the schools in the Cleveland public school system were in the center of a half-mile circle which did not contain a single intersection listed amount the 1,050 busiest intersections in Cuyahoga County. In contrast, only 14.0% (10 of 71) of the of the suburban public schools were located in this low range of vehicle traffic counts.

Higher percentages of the Cleveland public and Roman Catholic schools were also in the ranges above 50,000 vehicles per 12-hour period. Thirty-seven percent (49 of 131) of the Cleveland public schools and 48% (20 of 42) Roman Catholic schools were located in the center of circles having 50,000 or more vehicles through intersections. For the suburban public schools, 25% (17 of 69) schools were in the range above 50,000 vehicles per 12-hour period.

Housing Risk

The percent pre-1950 housing for census tracts of the Cleveland public and Roman Catholic schools were much higher than that of the Lutheran and the suburban schools. Frequency distributions of the percents of pre-1950 houses for Cleveland public, Roman Catholic, Lutheran, and suburban schools are given in Tables 5-8. These tables show that 61.8% (81 of 131) of the Cleveland public schools and 62.7% (27 of 43) of the Roman Catholic schools in Cleveland were located in census tracts in which 90% or more of the housing units were constructed before 1950. In the suburbs, however, only 16.17% of the schools were located in census tracts in which 90% or more of the housing units were constructed before 1950.

Mean Income

The frequency distributions of mean annual income show that many of the Cleveland public and parochial schools are located in census tracts having low annual incomes. For example, 59% (77 of 131) of the Cleveland public schools and 40% (17 of 43) Roman Catholic schools in Cleveland were located in census tracts with mean annual incomes of less than $10,000. In contrast, only two of the 68 suburban schools (2.9%) were located in census tracts having less than $10,000 mean income (Table 12). Furthermore, one of these two suburban schools does not represent a low-income area because it is located in a census tract which includes many housing units for college students. In the range of $12,000 to $13,000 mean incomes were located 44% (30 of 68) of the suburban schools (Table 12). Only 9.9% (13 of 131) Cleveland public schools were in this range. None of the Lutheran schools within Cleveland were in census tracts having less than $10,000 mean income (Table 11).

Racial Factor

The frequency distribution of the Cleveland public schools shows that 45% (59 of 130) schools had 0 to 10% white children and that 34% (44 of 130) had 90% to 100% white children (Table 13). Ethnic composition of the entire Cleveland public school system consisted of 57% black children; and 39% white children. The American Indian/Alaskan Native and the Asian/Pacific Islander groups were represented by 0.3%, and the Hispanic group included only 2.9%. Most children in schools having low percentages of white children were black children.

The frequency distribution of racial composition shows that 81% of the suburban schools had 95% to 100% white children (Table 13). All of the public schools in six suburbs had 95% to 100% white children. In the public school systems of three suburbs, one elementary school included in our study had less that 95% white children. The other schools in these three systems had 95% to 100% white children. Five of six schools in another suburb had 95% to 100% white children and 74% white children in the sixth school. In another system one school had 95% white children; 6 of 11, 81% to 94% white children, and one had 48% white children.

Lead Industries

The frequency distribution of Cleveland public, parochial, and suburban public schools shows that 76% (54) of the 71 suburban schools were located in areas which did not have a single lead industry within the half-mile radius of the school (Table 14). Only 21% of the Cleveland public and 29% of the parochial schools were surrounded by a half-mile radius which did not contain a single lead industry. None of the suburban schools had an industry score of more than four lead industries, but 24% (32 of 133) of the Cleveland public schools and 23% (12 of 52) of the parochial schools had more than five lead industries within the one-half mile radius of the schools.

Ambient Air Pollution

Scores for particulate, lead, cadmium, antimony, and SO_2 and data used to determine these scores are given in Tables 15-19. The percent of the air samples for total suspended particulate above the annual mean of 125.1 $\mu g/m^3$ for the 20 air collecting stations ranged from 82.8% (48 of 58 tests) for Air Station 1 to 12.2% (9 of 74 tests) for Air Station 12 (Table 16). More than half of the analyzed samples for Air Stations 1, 9, 10, 13, 15, 17 and 21 had particulate counts above 125 $\mu g/m^3$ during the year from August 1971 to August 1972.

The percent of samples with air lead above 1,515 ng/m^3 was 10% or more for 10 of 17 Cleveland air-collecting stations. (Table 17). For air station 10, 29% (15 of 51) of the tests for air lead were above 1,515 ng/m^3. Air Station 14 did not have any of the 34 tests for air lead above 1,515 ng/m^3.

Air cadmium levels were determined for the same 17 air stations included in the lead results (Table 18). All air stations except 19 which had 10% or more of the tests for air lead above 1,515 ng/m^3 also had 10 to 24% of their tests for cadmium above the baseline of 19.5 ng/m^3.

Antimony in amounts above 217 ng/m^3 was present in greater than 45% of the samples for two air stations in Cleveland (Table 19). The occurrence of air lead levels above 1,515 ng was only 3% (1 of 33) for air station 13, which had a 54.5% (18 of 33 tests) above 217 ng Sb/m^3.

LEAD ABSORPTION STUDY

Tooth Lead Levels

All Tooth Types--

The mean of lead in incisor and molar teeth of 5,333 children in the Cleveland public school system was 5.57 ± 2.05 mg/100 g of tissue (Table 20). The means of tooth lead for 3,704 children in nine suburbs ranged from a low of 4.70 ± 1.78 mg/100 g for 386 children in an eastern suburb to a high of 6.54 ± 2.54 for 134 children in a western suburb. These means for Cleveland and also for its suburbs are approximately the same as those reported by Needleman, Tuncay and Shapiro (1972) for 69 children in the "lead belt" of Philadelphia. Needleman and coworkers found 51.1 ± 10.9 ppm for the 69 children in the "lead belt" of Philadelphia.

The means of tooth lead of the 3,704 children in all nine suburbs of Cleveland were considerably higher than the mean of 11.1 ± 14.8 mg/100 g reported by Needleman and coworkers for 40 teeth from children living in a suburb of Philadelphia. However, our means of 4.70 ± 1.78 mg to 6.54 ± 2.54 mg/100g fall within the range reported by Needleman, Davidson, Sewall and Shapiro (1974) for white children living in newer houses. This mean of 41.7 ppm for lead in 304 white children was based upon samples of dentine tissue only. Our samples included enamel as well as dentine (Table 20).

The percentages of children who had 8.0 or more mg/100 g of tooth tissue also show that children living in the Cleveland suburbs are exposed to as much lead as are children living within the City of Cleveland. Elevated tooth lead of 8.0 or more ppm was present in the teeth of 13.0% (824) of the 6,326 Cleveland children and 12.6% (460) of the 3,653 children living in nine suburbs (Table 21), (Figure 1).

Comparisons of the prevalence of elevated tooth lead (8.0 or more mg/100 g) among school systems show that school systems in some suburbs had a higher prevalence of elevated lead than did children in the Cleveland public school system (Table 21). For example, 13.3% (712) of the 5,367 children in Cleveland public schools had 8.0 or more mg/100 g of tooth tissue. For 134 children in one suburb, the prevalence of elevated tooth lead was 27.6%. For 330 children in another suburb, the prevalence was 17.3% (Table 21).

The locations of suburbs and the prevalence of elevated tooth lead were not related to their distance from the inner city or to the location of the suburban area. For example, a suburb on the east side had the lowest prevalence of elevated lead, 5.2% or 20 of the 386 children. Furthermore, 15.8% or 28 of the 177 children living in the exurbs had 8.0 or more mg/100 g of tooth tissue. The prevalence of elevated lead was 21.8% for the hospital group. Many of the teeth from children in the hospital group, however,

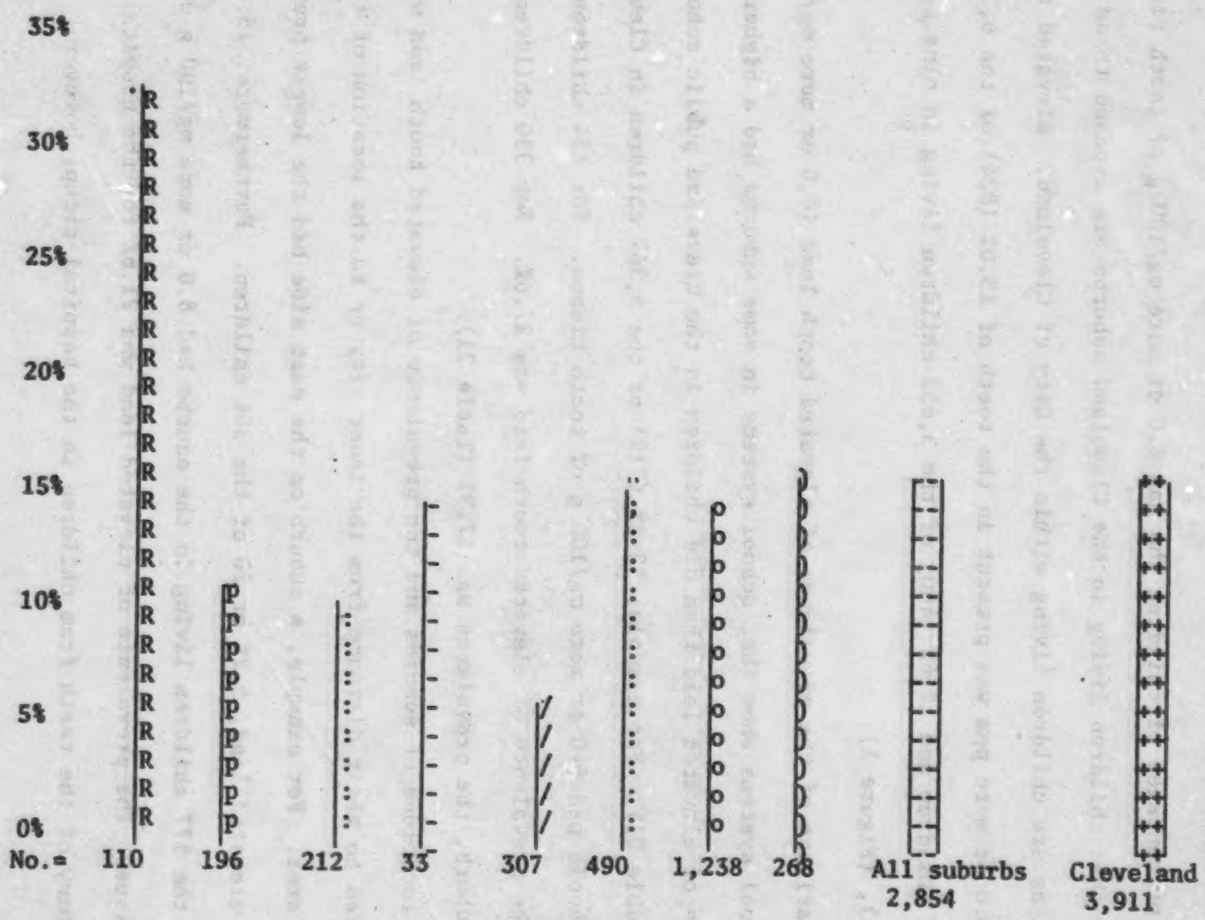

Figure 1. Percent occurrence of elevated tooth lead (8.0 mg+) for children living in eight Cleveland suburbs and the total % occurrence for all suburban and Cleveland children.

were extracted molar teeth.

Incisor and Molars (mean and elevated)

Shed and Incisor Crowns--

All teeth collected from the school systems were shed deciduous teeth. The use of incisor crowns for lead analyses was approximately the same for the three school systems in Cleveland and the nine suburbs listed in Tables 22 to 25. Incisor crowns without cavities or fillings comprise 75% (3,911) of the 5,203 teeth of children in the Cleveland public schools; 75% (620) of the 828 teeth of children in the Catholic schools; 73% of the 114 teeth in the Lutheran group; and 80% (2,854) of the 3,577 teeth from children in the suburban group.

Elevated tooth lead in incisor crowns of shed deciduous teeth which did not have cavities or fillings also show that children living in the suburbs of Cleveland are exposed to excess lead. The incidence of elevated tooth lead was 15.2% for the 3,911 Cleveland children and 15.5% for the 2,854 children in the nine suburbs (Tables 22-25, Figure 2).

Molar Crowns--

Molar crowns of teeth which did not have cavities or fillings comprised 17.6% (914) of the teeth of the children in the Cleveland public schools; 17.5% (145) of the Catholic group; 18.4% (21) of the Lutheran group; and 12.2% (435) of the suburban group. The prevalence of elevated tooth lead in molar crowns without cavities or fillings for the Cleveland public schools was 4.3%; for the Catholic schools, 6.9%; for the Lutheran schools, 14.3%; and for the suburban schools, 3.2% (Tables 22-25).

The frequency of elevated tooth lead was higher in molar crowns of

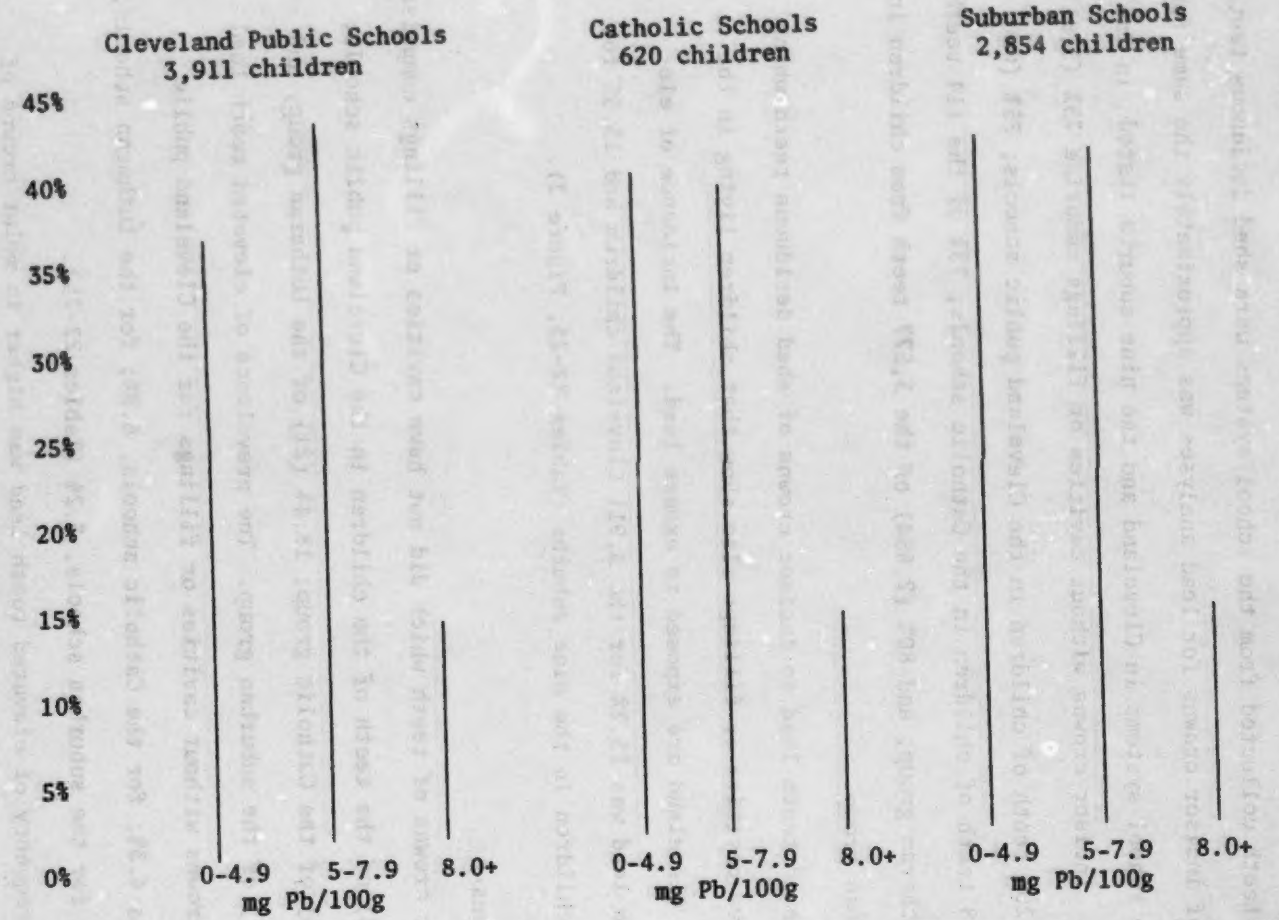

Figure 2. Percent occurrence of lead in the tissue of shed incisor crowns of teeth which did not have a cavity or filling.

teeth which had a cavity and/or fillings than in molar crowns of teeth which did not have a cavity or filling for the Cleveland public schools and the suburban schools. The frequency of elevated tooth lead was 9.3% for molar crowns with cavities and/or fillings, but only 4.3% for molar crowns without cavities or fillings for children in the Cleveland public schools (Table 22). The frequency of elevated tooth lead was 11.0% for molar crowns with a cavity and/or fillings, but only 3.2% for molar crowns without cavities or fillings for children in the suburbs (Table 25, Figure 3).

For the institution and hospital group, the incidence of elevated tooth lead in 157 molar crowns without cavities and/or fillings was 9.1%, compared with 9.3% for the Cleveland public schools and 11.0% for the suburban schools (Tables 22, 25, 26).

Incisor and Molar Roots--

Lead analyses on roots of incisor and molar teeth were done on a small percentage of the total tooth sample. Root tissue analyzed for lead included only 3.9% of the sample from children in the Cleveland public schools and 2.4% of the samples from children in the suburban schools (Tables 22-25). For the Cleveland public schools, the frequency of elevated lead was 19.2% for the incisor root tissue from 99 children; and 18.5% for molar root tissue from 54 children (Table 22). For the suburban public schools, the frequency of elevated lead was 23.6% for incisor root tissue of 42 children, but only 2.3% for molar root tissue of 43 children (Table 25). For the institution and hospital group, elevated lead was present in 27% of 547 teeth (Table 26). This incidence of elevated lead in molar root tissue (Table 26) is considerably higher than the 2.3% for molar root tissue from suburban children (Table 25).

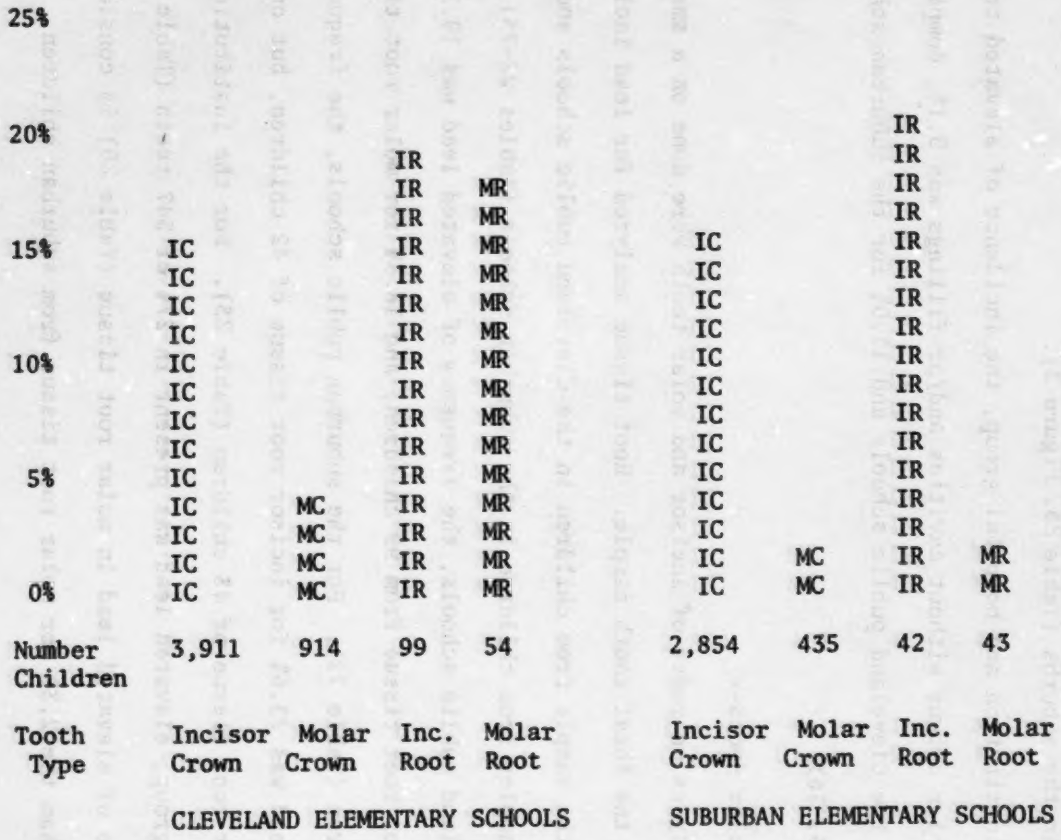

Figure 3. The % occurrence of elevated lead (8.0+ mg Pb/100 g) in tissues from incisor and molar crowns of teeth without cavities and/or fillings and in root tissues from incisor and molar teeth with and without cavities and/or fillings.

Shed Incisor Crowns Without Cavities or Fillings

Cleveland Public Schools--

The frequency distribution of tooth lead levels in incisor crowns without cavities or fillings are listed for each school in the Cleveland public system (Table 27). The number of teeth, which also represents the number of children, ranged from only one tooth to 94 in the various schools (Table 27). The prevalence of elevated tooth lead for the five schools having 70 or more samples ranged from 3.3% to 16.4%. The other three schools had 6.0%, 9.0% and 12.8% elevated tooth lead in incisor crown tissue from teeth not having a cavity or filling. The schools which had only 3.8% of elevated tooth lead levels had 60.8% of the 79 incisor teeth in the lowest range of tooth lead (0 to 4.9 mg Pb/100 g). The school which had 16.4% elevated tooth lead had 50.7% in the lowest range. The range in prevalence of elevated tooth lead levels found among the individual schools in Cleveland indicates that sources of lead exposures of children are related to local factors because children were not bused and attended their neighborhood school The differences were not due to variations in processing teeth because all steps in the preparation and analyses were done by random sampling as stated in the section on controls for error sources.

Catholic Schools--

The number of children and the percent frequency distribution of lead in shed incisor crowns of teeth not having cavities or fillings for 620 children in the 43 Catholic schools in Cleveland are given in Table 28. The five Catholic schools from which 30 or more samples were received ranged from 3.2%

to 18.9% of children having 8.0 or more mg Pb/100 g of incisor crown tissue from teeth not having a cavity or filling (Table 28). The percent of 8.0 or more Pb/100 g for the other three schools with 30 or more samples was 8.4%, 16.1% and 18.2%. One school with an incidence of 18.9% of elevated tooth lead is in an area near the Cuyahoga valley and had a vehicle count of 58,000. Another school with 8.4% occurrence of elevated tooth lead is in a western location near the airport.

Comparison of frequency distributions of Catholic schools in Cleveland with the Cleveland public schools shows that 46.5% of the 620 children in the Catholic schools were in the lowest range of 0 to 4.9 mg Pb/100 g, but that only 39.2% of the 3,911 Cleveland public school children were in this range.

Lutheran Schools--

The percent frequency distribution of lead in incisor crowns of teeth not having cavities or fillings for the five Lutheran schools in Cleveland and the five Lutheran schools in the suburbs are given in Table 29. This table contains data showing that elevated tooth lead was present in as many of the 44 children living in the suburbs as in the 39 children within Cleveland (Table 29).

Suburban Schools --

Percent frequency distributions of the amount of lead in shed incisor crowns of teeth not having cavities or fillings for children in the suburbs are given in Tables 40-45. The summary (Table 30) shows that one suburb had a 32.7% occurrence of elevated tooth lead for 110 children. This prevalence of elevated tooth lead is approximately twice that of the other suburbs. The range for these suburbs was 5.5% to 16.7% of elevated tooth lead (Table 30).

One elementary school in a suburb located near the industrial valley of the Cuyahoga River had 15.2% occurrence of elevated tooth lead. The lowest incidence of elevated tooth lead was 5.5% for 305 children living in an eastern suburb on the shore of Lake Erie.

The percent occurrence of elevated tooth lead in shed incisor crowns of teeth not having cavities or fillings show that greater variations occur between individual schools within a suburb than between the means of the suburbs (Table 30). For example, 22.7% of 75 children in one school and 7.8% of the 64 children in another school of one suburb (Table 31) had elevated tooth lead in incisor crown tissue. Similar variations in the percent of elevated are shown in the table for other suburbs (Tables 32-35).

Effects of Covariate Data on the Prevalence of Elevated Tooth Lead

Age has been considered a variable in the amounts of tooth lead. Brudevold and Steadman (1956) stated that lead is present in the enamel of unerupted and erupted teeth. Derise and Ritchey (1974) reported that lead in the enamel of permanent caries-free teeth increased from 43.0 ± 1.0 ppm for 39 children 10 to 12 years old to 48.8 ± 0.9 ppm for 44 adults over 25 years old. The amounts of lead in dentine also increased in these two groups from 38.9 ± 1.4 ppm to 51.5 ± 1.3 ppm in those who were over 25 years old.

Table 36 contains the percent frequency distribution of lead in teeth by age at loss of tooth and by residential history. Residential history was divided into two categories: children who had lived in the home where the tooth was lost 80-100% of their lives and children who had lived at that address less than 80% of their lives. In the 80-100% group are included 3,935 children or 35% of the total sample. Six-year-old children (1,130) represented 28.7% of the sample in the 80-100% group. Children less than 5 years old, 9, 11, and 12 years old represented less than 10% of the 3,935 children (Table 36 and Figure 4).

Tooth lead between the amounts of 4.0 to 5.9 mg Pb/100 g was present in 42.8% of the 80-100% lifespan group and in 44.2% of the 79% or less lifespan group. The incidence of tooth lead above 8.0 mg Pb/100 g was approximately the same for the two groups (Table 36 and Figure 4).

The percent incidence of elevated tooth lead was approximately the same for the 2,120 boys and the 2,799 girls in the Cleveland public schools (Figure 5). The percent incidence of elevated tooth lead was also approximately the same for the 770 boys and the 771 girls living in one suburb (Figure 6). Comparisons of the decrease in tooth lead shows that the decreased incidence of elevated tooth lead was the same for the Cleveland and suburban groups (Figures 5 and 6).

Pearson and Spearman correlations of age at the time of tooth loss and the amount of tooth lead show a significant decrease with age in tooth lead for shed deciduous teeth of children in all public and parochial school systems (Tables 37 and 38). However, this decrease with age, is not present in the "Hospital" group (Table 37). The "Hospital" group included a high percentage of extracted teeth.

The decrease of lead with age of children in our study differs from the reports of Derise and Ritchey (1974) for enamel and dentine of permanent teeth. The cause or causes for higher tooth lead in younger children living in the Cleveland metropolitan area are not known. The decrease with age may

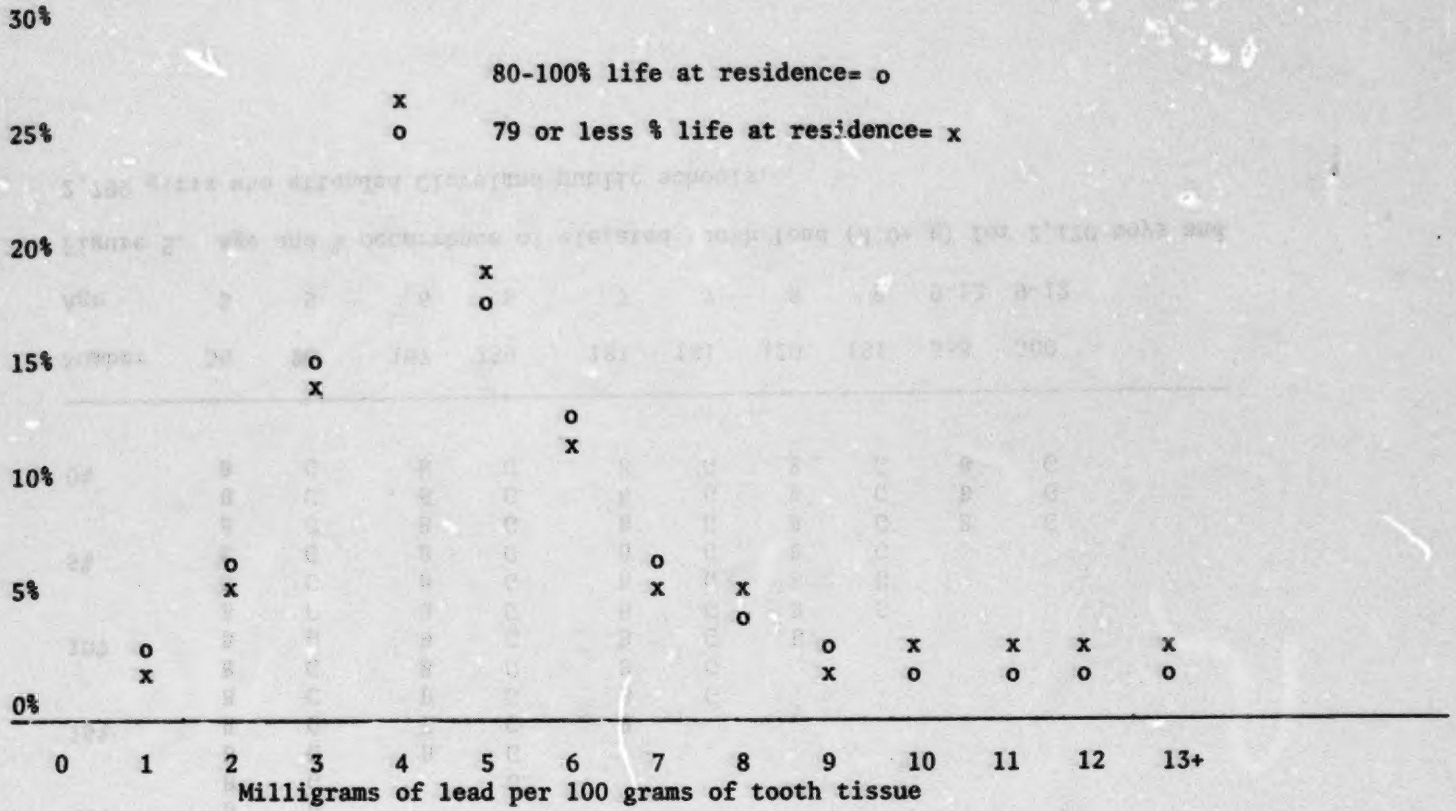

Figure 4. Percent frequency distribution of tooth lead in 3,935 children with 80-100% and in 7,306, 79% or less percent life residency at address where living when tooth was shed.

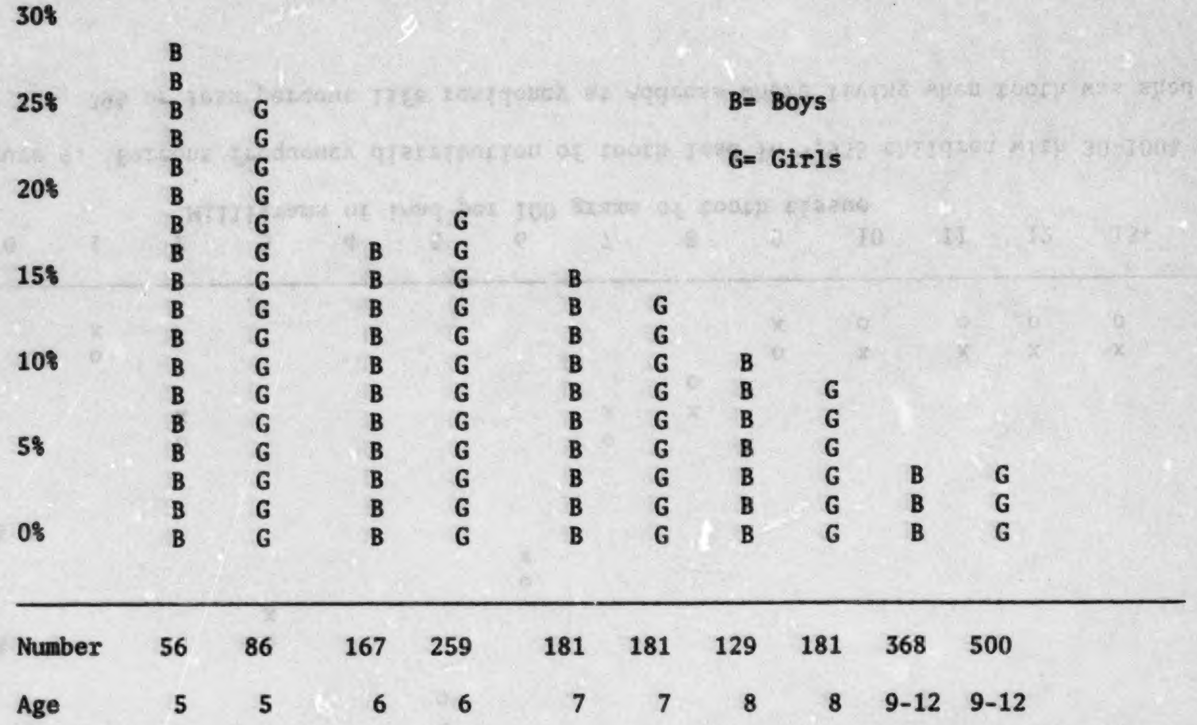

Figure 5. Age and % occurrence of elevated tooth lead (8.0+ g) for 2,120 boys and 2,799 girls who attended Cleveland public schools.

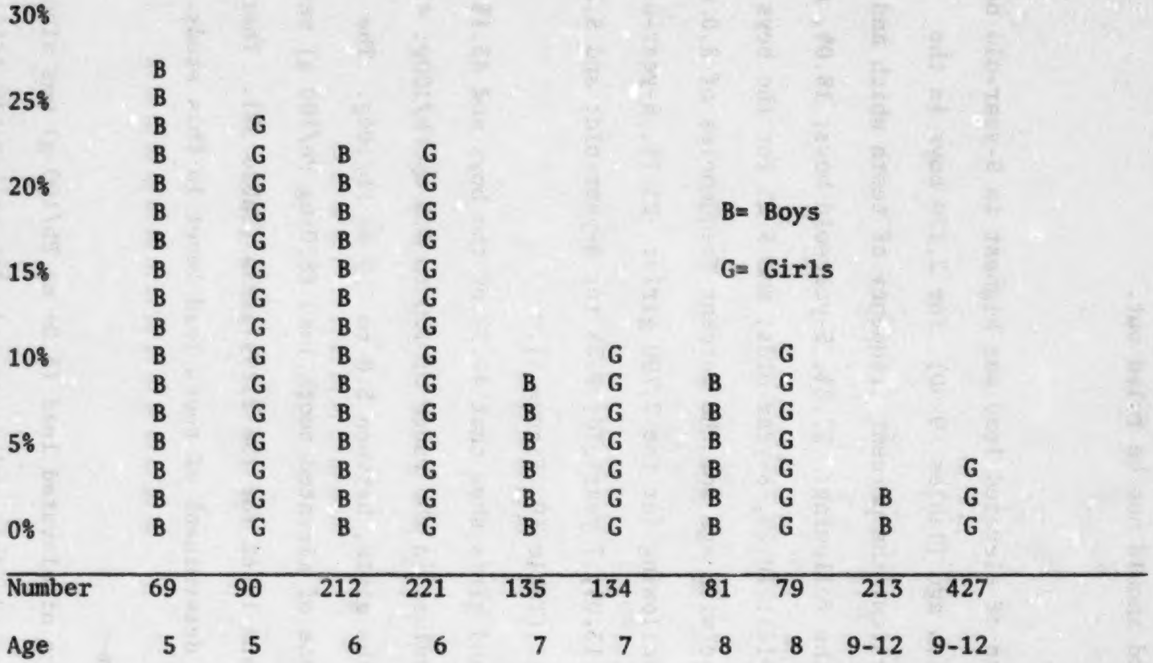

Figure 6. Age and % occurrence of elevated tooth lead (8.0+ mg/100 g) for 710 boys and 771 girls who lived in one suburb of Cleveland.

be related to a longer period for resorption of the teeth in the older children. The possibility of resorption decreasing the tooth lead would also account for the absence of a significant correlation between age and tooth lead for children in the "Hospital" group (Table 37). However, the possible factor of younger children being subjected to increased lead pollution during infancy and early childhood should not be ruled out.

Cleveland Public Schools--

The percent occurrence of elevated lead was highest in 5-year-old boys and girls and decreased with age (Tables 39-40) For 2,120 boys in the Cleveland public school system, the percent frequency of teeth which had 8.0 or more mg Pb/100 g were the following: 27.8%, 5-year-old boys; 18.0%, 6 year-olds; 15.3%, 7-year-olds; 10.2%, 8-year-olds; and 5.2% for the boys aged 9 through 12. The decrease with age for the percent frequencies of 8.0 or more mg Pb/100 g was the following for the 2,799 girls: 24.7%, 5-year-old girls; 17.7%, 6-year-old; 13.0%, 7 year-old; 9.2% for 8-year-old; and 5.2% for girls aged 9 through 12 (Table 39, Figure 5).

Comparisons of boys and girls show that 42.5% of the boys and 43.1% of the girls had tooth lead values in the range of 1.0 to 4.9 mg Pb/100g; 43.9% of the boys and 44.2% of the girls, between 5.0 to 7.9 mg Pb/100g. The percent frequency occurrence of elevated tooth lead (8.0+mg Pb/100 g) was 13.6% for the 2,120 boys and 12.6% for the 2,799 girls (Table 39). Therefore sex was not found to be a determinant of tooth lead level in this study.

One Suburban School System--

The percent occurrence of elevated lead (8.0+ mg Pb/100 g) was also highest in 5-year-old boys and girls and decreased with age (Table 40). In this one suburb, percent frequencies of teeth which contained 8.0+ mg Pb/

100 g were the following for 710 boys: 26.1% of the 5-year-old boys; 21.2% of the 6-year-old; 8.1% of the 7-year-old; 7.4% of the 8-year-old; and only 1.4% of the boys aged 9 through 12 years. The decrease in occurrence of elevated tooth lead was similar to the 771 girls in this suburban school system. The occurrence of elevated tooth lead for the girls was the following: 22.2% of the 5-year-old girls; 21.1%, 6-year-old; 11.9%, 7-year-old; 10.1%, 8-year-old; and 2.4% of the girls aged 9 through 12.

Frequency distribution by age was the following: 53.8% of the boys and 57.0% of the girls had tooth lead in the range of less than 1.0 mg Pb to 4.9 mg Pb/100g. The prevalence of boys and girls in the lowest range is 10% higher for the children in the one suburb than for the children in the Cleveland public schools (Table 40). Only 42.5% of the boys and 43.1% of the girls in the Cleveland public schools were in the lowest range of tooth lead (< 1.0 to 4.9 mg Pb/100 g) (Table 39).

The incidences of elevated tooth lead (8.0+ mg Pb/100 g) were 11.7% (83) for the 710 boys and 12.6% (97) for the 771 girls in this single suburb. The 12.6% of elevated tooth lead for the girls was the same incidence as for the 2,799 girls in the Cleveland public schools. However, the boys in the suburb had a slightly lower occurrence (11.7%) than did the 2,120 boys in the Cleveland public schools (13.6%) (Tables 39-40, Figure 6).

Elevated Tooth Lead and Lead Source

Data Description--

Data for the various environmental sources of lead for each school based on the methods described previously are presented in Tables 41-50.

The relation between the housing risk for the half mile radius around the school and the amounts of tooth lead in shed teeth included only those children who had lived the last 80% to 100% of their lifespan in the house where living when the tooth was shed. Tables 51 and 52 include the actual number and the percent of schools in the housing risks categories which were based upon the percent of pre-1950 housing units in the census tract in which the schools were located.

Sixty-six (27.6%) of the 239 elementary schools did not have any children with lead values above 8.0 mg Pb/100 g. Forty-two of these 65 schools were in census tracts in which 80% to 100% of the housing units were constructed before 1950. In the 64 schools having a 15% to 30% occurrence of elevated tooth lead, 38 of the 64 were in census tracts having 80% to 100 % pre-1950 housing (Tables 51-52).

Approximately one-fifth (47) of the 223 schools included in Table 53, which pertains to lifespan residency and vehicle traffic, did not have a single intersection listed among the 1,050 busiest intersections in Cuyahoga County within a one-half mile radius of the school. The 47 schools included 19 schools with an incidence of 15% or more of the children having elevated tooth lead. In the range of 35,000 to 69,000 vehicles per 12-hour period were 65 schools with elevated tooth lead in 15% of the children tested. The percent of schools with more than a 15% occurrence of elevated tooth lead (8.0+ mg) was 8.4% for the 47 schools which did not have a single intersection listed among the 1,050 busiest intersections. The percent of schools with more than a 15% occurrence of elevated tooth lead was 11.1% for the 65 schools which had vehicle counts in the range of 35,000 to 69,000 (Tables 53-54).

Approximately one-half (49.6%) of the 238 schools were located in census tracts having $6,600 to $10,900 mean annual income (Tables 55-56). In this group of 118 schools, 47 schools had 15% or more children with elevated tooth lead. In the income range of $15,000 or higher, 7 of the 18 schools had 15% or more children with elevated tooth lead. There was not, therefore, a decrease in the prevalence of elevated tooth lead in children attending schools in census tracts with higher mean annual incomes. In fact, the incidence was essentially the same: 39.9% of the 118 schools in the $6,600 to $10,900 range and 38.9% of the 18 schools in the $15,000 or higher mean incomes (Tables 55-56).

Correlation Analysis--

The 126 Cleveland public and the 46 parochial schools in Cleveland had significant negative correlations between housing risk and the mean annual income. Both Pearson and Spearman coefficients of correlation show that there was not significant correlations between the percent occurrence of 8.0 or more mg Pb/100g of tooth tissue for the school and the following scores of the schools: % pre-1950 housing, % white children, mean annual income of the census tract in which schools were located, and the number of vehicles passing through major intersections within a half-mile radius of the school (Tables 57-58). The number of lead industries within a one-half mile radius of the 126 Cleveland public schools was significantly correlated with the percent incidence of elevated tooth lead in children in these schools. The parochial and suburban school systems did not have significant correlations between the number of lead industries and the percent occurrence of elevated tooth lead (Tables 57-58).

The housing risk (% pre-1950 houses) was significantly negatively correlated with the mean annual income and the number of lead industries within the half-mile radius of the 126 Cleveland public schools (Tables 57-58). For the 46 parochial schools, there was also a significantly negative correlation between the % pre-1950 houses and mean income. The % pre-1950 housing was significantly positively correlated with the vehicle traffic and the number of lead industries. For the 67 suburban schools, there was a signficantly negative correlation between the % pre-1950 houses and the % white children. The correlation between the % pre-1950 houses and the number of lead industries was signficantly positively correlated for the 67 suburban schools (Tables 57-58).

The % white children in the 126 schools of the Cleveland public schools was, as expected, positively correlated with mean annual income and negatively correlated with the number of lead industries. However, the 67 suburban schools did not have significant Pearson coefficients of correlation between the % white children and mean income or the expected negative correlation between % white children and the number of lead industries. The % white children was negatively correlated with vehicle traffic.

Two other correlations were signficant. Mean annual incomes of the census tracts of schools were negatively correlated with the number of lead industries for the three groups of schools: Cleveland public, parochial, and suburban. Secondly, the Pearson coefficients of correlation between vehicle traffic and the number of lead industries were signficantly positive correlations for the parochial and suburban schools. The correlation between vehicle traffic and lead industries was not significant for the Cleveland public schools (Tables 57-58).

Relationship between Elevated Tooth Lead and Ambient Air Pollution

Tooth Lead and Air Scores--

The percent incidences of elevated tooth lead in schools within a mile radius of each air station are listed in Table 59. Air stations are identified by the encircled numbers on the map. Schools are identified on the map by two letters.

A wide range of differences occur in the percent occurrences of elevated tooth lead of schools within the mile radius of an air station. For example, the percent occurrence of 8.0+ mg Pb/100 g of tooth lead in schools within the mile radius of the same air station ranged from 0 to 23% elevated tooth lead for schools in air stations numbered 2, 4, 5, 14 and 15; and from less than 7% to more than 20% for schools within a mile radius of air stations numbered 1, 6, 7, 9, 10 and 17. Air station 3, which is near the industrial valley, had four schools with the following percent occurrences of elevated tooth lead: 14.6% of 96 children; 18.2% of 22; 16.7% of 30; 20.3% of 64; and 44.4% of 9 children. The % pre-1950 housing, % white children, and the mean income for these four schools were approximately the same. The vehicle traffic ranged from "0" to 100,000 vehicles for these four schools.

Some schools in the industrial valley of the Cuyahoga River had relatively low percentage occurrences of elevated tooth lead. For example, in air station 1, only 3.6% of the 28 children in one school had tooth lead values above 8.0 mg Pb/100 g.

Vehicle Traffic and Air Scores--

The vehicle score of schools ranged from "0" to 50,000 or more vehicles per 12 hour period for the mile radius around 6 of the 20 air collecting stations. Most schools within the mile radius of #2 and #7 air stations were surrounded by a mile radius of very heavy traffic. Schools in these two air stations, however, did not have higher percent occurrences of elevated tooth lead.

Housing and Air Scores--

The percent of pre-1950 houses for schools were approximately the same for most schools within a mile radius of an air station. For example, in air station 2, the percent pre-1950 housing ranged from 82 to 100%. For air station 4, the percent pre-1950 housing ranged from 89% to 100%.

Correlation Analysis--

Pearson and Spearman correlations show that air lead scores were not correlated with the scores for air particulate (Tables 60-61). However, air lead was significantly negatively correlated with air antimony for both the Cleveland public and parachial groups of schools. Air lead and SO_2 for the parochial schools were negatively correlated by both the Pearson and Spearman methods. However, the air lead and SO_2 for schools in the Cleveland public school system were not significant.

Other significantly negative correlations occurred between air cadmium and SO_2 for both groups of schools. Significantly positive Pearson and Spearman correlations were present between air particulate and air SO_2 scores for both the Cleveland public and the parochial schools (Tables 60-61).

Air lead levels were not found to be related to the prevalance of elevated tooth lead levels (8.0 mg+/100 g) for either the Cleveland public schools nor the parochial schools.

NEUROLOGICAL EFFECTS OF LEAD

Evaluations of physical, emotional and learning characteristics were done by teachers on 6,480 children in 25 elementary schools in the Cleveland public school system. Five of these schools had less than 10% occurrences of elevated tooth lead and five had 25% or higher occurrences of elevated tooth lead. The other 15 schools were in the range of 11% to 24.6% elevated tooth lead. Lead toxicity has been postulated to be associated with the physical, emotional, and learning disabilities some of which were included in the teacher evaluations of children at the end of the school year.

Teachers' Evaluations

Table 62 presents the results of the teacher evaluations by school and gives the prevalence of elevated tooth lead as well as the number of children evaluated. Table 63 presents data from the 24 Cleveland schools which had teeth lead data available which show that 8.1% of the 6,480 children evaluated with tooth lead data available were left-handed. This percentage varied from 8.9 to 9.3% in children aged 7-12. Teachers reported that 1.3% (84) of the 6,480 children were known by them to be receiving medication. The percent of children receiving medication was lowest in the 5-year-olds and highest in 10 and 11-year-old children (Table 63).

Seven-year-old children had the highest index of learning disabilities (13.7) and emotional symptoms (10.3) (Table 63). The learning difficulties included regressions in writing and drawing, reading, and speech; confused, poor memory; difficulty in arithmetic; and short attention span. The emotional symptoms includes restlessness, cries easily, aggressive behavior, impulsive, temper outbursts, emotional instability; cruel behavior, withdrawn, bangs head, and unpopular with peers. The incidence of the physical disabilities (5.2) observed by teachers was highest in 8-year-old children (Table 63).

Relationships of Variables to Teacher Evaluations

Pearson and Spearman coefficients of correlation between % white children and the learning score were negatively significant (Tables 64-65). Significantly negative Pearson correlations also occurred between race and the emotional scores (Table 64). The Spearman correlations of % white children with the physical as well as the emotional and learning scores were negatively significant (Table 65).

Scores of the teacher evaluations for six schools having 96% to 100% black children and eight schools having 96% to 100% white children are given in Table 66. The mean for elevated tooth lead was 20.5% for the six schools having black pupils and 21.4% for the eight schools having white children. The percent occurrences of left-handedness and the use of medication, and the emotional and physical scores showed greater variations between schools than between racial composition of the schools (Table 66). The learning disabilities had an index above 10 for 4 of 6 schools having black children and above 10 for 2 of 8 schools having white children (Table 66).

The Spearman correlations between the number of lead industries and the presence of physical symptoms was significant, but the Pearson correlations between lead industries and physical symptoms was only of borderline (0.65) significance (Tables 64-65). None of the Pearson and Spearman correlations between % left-handed, % use of medication, and the physical, emotional, and learning scores of the schools was significantly correlated with the housing risk, mean income or vehicle traffic counts of schools (Tables 64-65).

Relations of Teacher Evaluation Subscores

Significantly positive correlations occur between the following items of the teacher evaluations: % left-handed with % use of medication; % use of medication with physical scores; physical scores with emotional and with learning scores; and learning scores with the physical and emotional scores (Tables 67-68). Left-handedness was included in the scoring by teachers because of observations that left-handed children may have emotional symptoms more frequently than do right-handed children. The Pearson coefficient of correlation between the % left-handed and the emotional score was 0.56; and the Spearman correlation was 0.06 (Tables 67-68).

Teacher Evaluation Scores and Ambient Air Exposures

Significantly negative Pearson and Spearman correlations occurred between the % left-handed children in schools and the % SO_2 tests which were above 80 $\mu g\ SO_2/m^3$ (Tables 69-70). This negative correlation may mean that more right-handed children lived in areas of SO_2 pollution, rather than there being any cause-effect relation between right-handedness and SO_2 pollution. Use of medication was not correlated with particulate, air lead, air cadmium, air antimony, or SO_2 (Tables 69-70).

Air antimony scores (% tests above 217 ng/m3) and the school scores for % left-handed, use of medication, and the scores for physical, emotional, and learning symptoms of lead toxicity were not significant in the Pearson correlations (Table 69). However, the % left-handed and air antimony were signficantly negative correlants in the Spearman correlations (Table 70).

Air lead samples above 1,515 ng/m^3 during the year of August 1971-1972 were signficantly positively correlated with the physical, emotional, and learning scores of schools. Both the Pearson and Spearman correlations between % of air lead tests above 1,515 ng Pb/m^3 and the scores of the physical, emotional, and learning disabilities were significant. Pearson coefficients of correlation between % air lead tests above 1,515 ng Pb/m^3 with the score of physical symptoms was .028; with the emotional symptoms, .008; and with the learning disability scores, .019. The Spearman correlations between % air lead tests above 1,515 ng Pb/m^3 with the physical symptoms was .019; with emotional symptoms, .004; and with the learning disabilities associated with lead toxicity, .003. These significant correlations indicate a need for additional research on the effects of this level of air lead pollution on physical, emotional, and learning symptoms and disabilities of lead toxicity. A time lapse was involved in relating the data on teacher evaluations to the air statistics for the period of August 1971 to August 1972. Lead has been shown to have residual effects on emotional and learning abilities of children (Bryce-Smith, 1972; De la Burde and Choate, 1972).

Teacher Evaluations for the Suburbs

Teachers in 26 elementary schools in seven suburbs scored 11,400 children for physical and emotional symptoms and for learning disabilities associated with lead toxicity. These children were evaluated at the end of the school year (Tables 71-72). Comparisons of the evaluations of children in the seven suburbs with the 6,497 children in the 24 Cleveland public schools indicate the following: The percent of suburban children who were considered to be left-handed was 9.1%; the % for Cleveland children, 8.1%. The percent occurrence of children known to be taking medication was 2.1% for

for the suburban children and 1.1% for the Cleveland children (Tables 71,63).

Scores for physical symptoms were as high or higher than the physical symptom score of Cleveland in three of the seven suburbs. Scores for the emotional characteristics were as high in one suburb (10.8) as for the 24 schools in the Cleveland system (9.2). In six of the seven suburbs (Table 63), the scores for learning disabilities were lower than for Cleveland (Table 71). In one suburb, the learning disability score was 10.0 compared with 10.2 for the 25 Cleveland schools.

Age was a factor in the number of learning disabilities reported in the suburbs (Table 72). Eight-year-old children in one school system had the highest index of learning disabilites (Table 72). The learning disability score in this suburb was 7.2 for 4,497 of the children in this suburb. In another suburb, five-year-old children had the highest learning disability score (22.0) and the seven-year-olds had 12.8. The learning disability score for seven-year-olds in the Cleveland public schools was 13.7.

Comparison of teacher evaluations for the 26 individual schools show that greater diversity occurs between individual schools of a single suburb than between the means of suburban school systems or between the suburbs and the Cleveland public schools (Tables 71,72). Variations in scores of the learning disabilities ranged from 1.4 to 10.8 in one suburb (Table 63) and from 3.7 to 15.3 in another suburb (Table 63). The ranges for emotional and physical scores also show that there were greater differences in scores between individual schools within a suburb than between means of the suburbs or between the means of the suburbs and the Cleveland public schools. Since data on air lead were not available for the suburbs, the % tests for air lead above 1,515 ng Pb/m^3, correlations could not be made to determine if the

% air lead tests above 1,515 ng Pb/m^3 were positively correlated with the physical, emotional, and learning disabilities associated with lead toxicity as were the correlations between air lead and the scores of the physical, emotional, and learning disability scores for the Cleveland public schools.

SECTION 4

DISCUSSION

SUMMARY OF RESULTS

Lead Absorption Study

Analyses of data on lead in deciduous teeth show that as many suburban children were exposed to excess lead as were children living within the City of Cleveland. Elevated tooth lead (8.0 or more mg Pb/100 g) was present in 12.6% (460) of the 3,653 children who lived in nine suburbs located at varying distances in all three directions from the center of Cleveland. This amount of tooth lead (8.0+ mg Pb/100 g) was present in 13.2% (834) of the 6,326 children living within the City of Cleveland. Incisor crown tissue from teeth which did not have a cavity and/or filling comprised 75% of the tooth samples of the Cleveland children and 80% of the samples of the suburban children. The incidence of elevated tooth lead (8.0+ mg Pb/100 g) in the shed incisor crowns of teeth not having a cavity and/or filling was 15.2% of the 3,911 Cleveland children and 15.5% of the 2,854 children who lived in the nine suburbs.

Means of tooth lead show that suburban children were exposed to as much lead as were the children living within the City of Cleveland. The mean tooth lead was 5.57 mg Pb/100 g for the 5,333 children in the Cleveland public schools. Means of tooth lead in four of the nine suburban school systems was higher than the mean for Cleveland. The means for these four suburbs were

6.54, 5.7, 5.68 and 5.7 mg Pb/100 g. The mean tooth lead for the other five suburban school systems were only slightly lower than the mean for the Cleveland schools. Needleman and coworkers quantitated lead in dentine of the teeth of 761 Philadelphia school children. They reported that 174 black children living in areas of deteriorated housing had a mean of 198 micrograms per gram of dentine. This value (19.8 mg/100 g) of dentine is considerably higher than our means because dentine samples were used.

Needleman, Tuncay and Shapiro (1972) also determined the amount of lead in 69 teeth from children in the "lead belt" of Philadelphia and in 40 teeth from children living in the suburbs. They found that tooth lead levels were high in areas where lead eating by children is frequent. All of these teeth were obtained from dentists. The mean tooth lead for the "lead belt" was 51.1 ± 109 ppm and for the suburbs, 11.1 ± 14.8 ppm. Stewart (1974) studied lead in extracted deciduous molars of 310 children who were 3 to 10 years old and who lived in Northern Ireland. They found that the greatest amounts of tooth lead occurred in children who lived in urban environments. The tooth samples used by Stewart (1974) included 148 children in Belfast, Ireland, 91 suburban children and 71 rural children.

The frequency distributions of tooth lead in children included in our study also show that suburban children are being exposed to as much lead as are the Cleveland children. The frequency distributions of lead in the shed incisor crown tissue of teeth which did not have a cavity and/or filling show the following: In the low range of 0 to 4.9 mg Pb/100 g were 39% of the 3,911 Cleveland children and 42% of the 2,854 suburban children. In the high range of 8.0 + mg Pb/100 g were 52.2% of the Cleveland children and 15.2% of the suburban children.

The percent occurrence of elevated tooth lead decreased with age at time of tooth loss. For five-year-olds in Cleveland, 28% of the boys and 25% of the girls had 8.0 or more mg Pb/100 g. For five-year-olds in the suburbs, 27% of the boys and 28% of the girls had 8.0+ mg Pb/100 g. The percent of the eight-year-olds who had 8.0+ mg Pb/100 g was 10.7% for boys and 10.3% for girls living in Cleveland; and 10.5% for boys and 8.3% for girls living in the nine suburbs.

Coefficients of correlations between tooth lead and age show that the tooth lead decreased with age at time of tooth loss. The negative correlations between tooth lead and age were significant for each individual school, for each of the nine suburban school systems, and for the Cleveland public and parochial school systems. The cause or causes for greater amounts of tooth lead in younger children are not known. Were the younger children subjected to more lead during infancy and early childhood? Did these children as infants drink milk products containing greater quantities of lead? Lamm, Cole, Glynn and Ullmann (1973) state that infants fed certain milks and milk concentrates during the first three months of infancy probably had positive lead balance. The decrease of tooth lead with age of the children in our study, however, may be due to greater loss of lead during a longer period for resorption of roots of the teeth shed by the older children.

The mean income of census tracts in which schools were located was not related to the percent occurrence of 8.0 or more mg Pb/100 g of tissue from the teeth of children attending the school. A 15% or higher occurrence of elevated tooth lead for schools was present in 47 (38.8%) of the 118 schools located in census tracts having a mean annual income in the range of $6,000 to $10,000. A 15% or higher incidence of elevated tooth lead occurred in

7 (38.9%) of the 18 schools located in census tracts with mean annual incomes of $15,000 or higher. However, mean income was negatively correlated with the percent of pre-1950 housing, percent of white children, and the number of lead industries for the Cleveland public and parochial schools. For the suburban schools, mean income of the census tracts of schools was not related to the percent occurrence of elevated tooth lead, percent of pre-1950 housing, percent of white children, or to vehicle traffic. A significantly negative correlation did occur between mean income of census tracts of schools and the number of lead industries around the 67 suburban schools.

As expected, the housing risk (% pre-1950 housing units in the census tracts of schools) was greater for the Cleveland public schools than for the suburban schools. For Cleveland, the housing risk was not related to the occurrence of elevated tooth lead or to vehicle traffic around the 126 Cleveland public schools. The housing risk was positively correlated with the number of lead industries and negatively correlated with the % white children and the mean income. For the 67 suburban school, the housing risk was not related to elevated tooth lead or to mean income, but was directly correlated with vehicle traffic and the number of lead industries.

The number of lead industries in the half-mile radius around the Cleveland public schools may be related the percent occurrence of elevated tooth lead because the Pearson coefficient of correlation between elevated tooth lead and lead industries was of borderline signficance. For the suburban group of schools, however, the percent occurrence of elevated tooth lead was not related to the number of lead industries in the half-mile radius around the schools. As expected, the number of lead industries was directly related to the % pre-1950 housing and indirectly related to mean income for both the Cleveland public and the suburban groups of schools.

The risk of vehicle traffic was not significantly correlated with the percent incidence of elevated tooth lead for the Cleveland public and parochial schools or for the suburban schools. Contrary to what might be expected, almost twice as many Cleveland public as suburban public schools were located in the center of a half-mile radius having low vehicle counts. For the Cleveland public schools, 39% were located in the center of a one-half mile radius which did not contain a single one of the 1,050 busiest intersections in Cuyahoga County. In contrast, only 14% of the suburban schools were in the center of a radius which did not contain any of the 1,050 of the busiest intersections.

Neurological Effects Study

The evaluations of the physical effects, emotional symptoms, and the learning disabilities possibly related to lead toxicity by teachers at the end of the school year included 6,497 children who attended 25 public schools in the City of Cleveland. The scores for physical, emotional, and learning symptoms of lead toxicity were not related to the percent occurrence of elevated tooth lead in children attending these schools.

The percent of air lead tests which were 1,515 nannograms or above for the air stations in which schools are located were significantly and directly correlated with each of the three (physical, emotional, and learning scores) measurements of lead toxicity. In addition, Pearson coefficients of correlation between air lead and the physical, emotional, and learning scores were significant and directly correlated. The significantly positive coefficients of correlation between air lead and the physical, emotional, and learning scores for children in the City of Cleveland indicate that high levels of atmospheric lead (1,515 ng Pb/m^3) or above was related to the lead toxicity symptoms included in the forms used by teachers to evaluate children at the end of the school year.

IMPLICATIONS OF RESULTS AND RECOMMENDATIONS

These data on lead in shed deciduous teeth show that as many suburban children were exposed to excess lead as were children who live within the City of Cleveland. Furthermore, the percent occurrence of elevated tooth lead decreased with age of children who lived in Cleveland and in the suburbs. The exposure of suburban children to excess lead and the higher occurrence of elevated tooth lead in the younger children indicate that programs to prevent lead pollution and the harmful effects of lead toxicity should not be limited to the City, but should be extended to include preschool children who live in the Cleveland suburbs.

This study on tooth lead included a sample of 3,653 suburban children. Previous studies on tooth lead in Philadelphia and other metropolitan areas included relatively small samples of suburban and rural children. It would appear that tests for tooth lead and that blood-testing programs should be considered for or extended to include preschool children who live in the suburbs of other large cities.

The positive correlation between the percent of air lead tests above 1,515 ng Pb/m^3 and the symptoms of the physical, emotional and learning disabilities associated with lead toxicity applied only to children living within the City of Cleveland. In order to establish the importance of air lead in relation to the physical, emotional and learning symptoms of lead toxicity, the symptoms of lead toxicity which were included in our teacher evaluation form should be related to the percent of tests for air lead above 1,515 ng/m^3 in another metropolitan area.

The percent occurrence of 8.0 or more mg Pb/100 g in deciduous teeth of children in schools was not correlated with school scores of mean income, percent pre-1950 housing, and vehicle traffic. We did not have the opportunity for follow-up research to determine if these socio-economic variables applied to the individual child. There were 840 Cleveland children and 460 suburban children who had 8.0+ mg Pb/100 g of tooth tissue. The significance of the proximity of lead industries in relation to tooth lead and the location of homes of these individual children need also to be determined.

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3. Report Number 1.2. 1-001 of the State of Ohio Department of Education, Division of Computer Services Statistical Reports of 1975-76. School Enrollment during the First Full Week in October.
4. Map Prepared by Regional Planning Commission, Cuyahoga County, Ohio, August 1975.
5. 1972 Directory of Ohio Manufacturers, Bureau of Economic Research, Ohio Deptment of Development, 27 edition, vol. 1.
6. Extensive 1-year Survey of Trace Elements and Compounds in the Airborne Suspended Particulate Matter in Cleveland, Ohio. R.B. King, J.S. Fordyce, A.C. Antoine, H.F. Leibecki, H.E. Neustadter, and S.M. Sidik, Lewis Research Center, Cleveland, Ohio 44135. NASA Technical Note TN, D8110, NASA, Washington, D.C. 1976.

FORM USED BY TEACHERS FOR EVALUATIONS OF SYMPTOMS OF LEAD TOXICITY

Please evaluate this child for each condition in the left column by checking "Yes", "Average", or "No" in the right columns. Any additional comments are welcome.

Number in Grade Book ______ School ______ Room ______ Sex ______ Age ______

	YES	AVERAGE	NO
1. Restless			
2. Cries easily			
3. Awkward gait			
4. Convulsions			
5. Aggressive behavior			
6. Impulsive			
7. Temper outbursts			
8. Emotional instability			
9. Tremor of hand			
10. Regression in writing or drawing			
11. Regression in reading			
12. Regression in speech pattern			
13. Muscular incoordination			
14. Confused			
15. Cruel behavior			
16. Withdrawn			
17. Poor memory			
18. Bangs head			
19. Upopular with peers			
20. Difficulty in arithmetic			
21. Short attention span			
22. Squints eyes			
23. Left-handed			
24. Ambidextrous			
25. Maturation lag			
26. Medication			

Please use back of page for additional remarks.

TABLE 1. FREQUENCY DISTRIBUTION OF HWAY SCORES FOR THE 131 PUBLIC ELEMENTARY SCHOOLS WITHIN THE CITY OF CLEVELAND

RANGE OF VEHICLES	NUMBER OF SCHOOLS	% OCCURRENCE OF SCHOOLS
*0 - 199	39	29.77
200 - 9,999	2	1.53
10,000 - 19,999	11	8.40
20,000 - 29,999	9	6.87
30,000 - 39,999	13	9.92
40,000 - 49,999	8	6.11
50,000 - 59,999	12	9.16
60,000 - 69,999	8	6.11
70,000 - 79,999	5	3.82
80,000 - 89,999	6	4.58
90,000 - 99,999	2	1.53
100,000 - 110,999	6	4.58
110,000 - 119,999	3	2.29
120,000 - 129,999	2	1.53
130,000 - 139,999	2	1.53
140,000 - 149,999	0	0.0
150,000 - 159,999	0	0.0
160,000 - 173,000	3	2.29

* The "0" figure means that there were no intersections included in the list of the 1,050 busiest intersections in Cuyahoga County within the one-half mile radius around each elementary school.

TABLE 2. FREQUENCY DISTRIBUTION OF HWAY SCORES FOR 42 ROMAN CATHOLIC SCHOOLS WITHIN THE CITY OF CLEVELAND

RANGE OF VEHICLES	NUMBER OF SCHOOLS	% INCIDENCE OF SCHOOLS
*0 - 199	6	14.28
200 -- 9,999	2	4.76
10,000 - 19,999	5	11.90
20,000 - 29,999	3	7.14
30,000 - 39,999	4	9.52
40,000 - 49,999	2	4.76
50,000 - 59,999	5	11.90
60,000 - 69,999	4	9.52
70,000 - 79,999	1	2.38
80,000 - 89,999	3	7.14
90,000 - 99,999	4	9.52
100,000 - 109,999	1	2.38
110,000 - 119,999	0	0.0
120,000 - 129,999	0	0.0
130,000 - 139,999	1	2.38
140,000 - Plus	1	2.38

* The "0" figure means that there were no intersections included in the list of the 1,050 busiest intersections in Cuyahoga County within the one-half mile radius around each elementary school.

TABLE 3. FREQUENCY DISTRIBUTION FOR HWAY SCORES FOR 9 ELEMENTARY LUTHERAN SCHOOLS IN CLEVELAND AND THE SUBURBS

RANGE OF VEHICLES	NUMBER OF SCHOOLS	% INCIDENCE IN SCHOOLS
0 199	4	44.44
200 - 9,999	0	0.0
10,000 - 19,999	2	22.22
20,000 - 29,999	0	0.0
30,000 - 39,999	0	0.0
40,000 - 49,999	1	11.11
50,000 - 59,999	2	22.22

*The "0" figure means that there were no intersections included in the list of the 1,050 busiest intersections in Cuyahoga County within the one-half mile radius around each elementary school.

TABLE 4. FREQUENCY DISTRIBUTION OF HWAY SCORES FOR 69 ELEMENTARY PUBLIC SCHOOLS IN THE SUBURBS OF CLEVELAND

RANGE OF VEHICLES	NUMBER OF SCHOOLS	% INCIDENCE
*0- 199	10	14.49%
200- 9,999	3	4.35%
10,000- 19,999	12	17.39%
20,000- 29,999	16	23.19%
30,000- 39,999	8	11.59%
40,000- 49,999	3	4.35%
50,000- 59,999	2	2.90%
60,000- 69,999	8	11.59%
70,000- 79,999	2	2.90%
80,000- 89,999	2	2.90%
90,000- 99,999	2	2.90%
100,000- 160,200	1	1.44%

* The 0 Figure means that there were no intersections included in the list of the 1,050 busiest intersections in Cuyahoga County within the one-half mile radius around each elementary school.

TABLE 5. FREQUENCY DISTRIBUTION OF PERCENT HOUSING CONSTRUCTED BEFORE 1950 IN THE CENSUS TRACTS IN WHICH THE 131 CLEVELAND PUBLIC SCHOOLS WERE LOCATED

RANGE % OF PRE 1950 HOUSING	NUMBER OF SCHOOLS	% OF SCHOOLS
0 - 19	2	1.52
20 - 29	2	1.53
30 - 39	3	2.29
40 - 49	6	4.58
50 - 59	6	4.58
60 - 69	4	3.05
70 - 79	12	9.16
80 - 89	15	11.45
90 -100	81	61.83

TABLE 6. FREQUENCY OF DISTRIBUTION OF PERCENT OF HOUSING CONSTRUCTED PRIOR TO 1950 FOR THE CENSUS TRACTS IN WHICH THE 43 ROMAN CATHOLIC ELEMENTARY SCHOOLS WERE LOCATED

RANGE % OF PRE 1950 HOUSING	NUMBER OF SCHOOLS	% OF SCHOOLS
40 - 49	3	6.97
50 - 59	1	2.32
60 - 69	3	6.97
70 - 79	3	6.97
80 - 89	6	13.95
90 -100	27	62.79

TABLE 7 FREQUENCY DISTRIBUTION OF PERCENT HOUSING CONSTRUCTED PRIOR TO 1950 IN THE CENSUS TRACT IN WHICH THE 10 ELEMENTARY LUTHERAN SCHOOLS IN CLEVELAND AND THE SUBURBS WERE LOCATED

RANGE % OF PRE 1950 HOUSING	NUMBER OF SCHOOLS	% IN SCHOOLS
10 - 19	1	10.0
20 - 29	0	0.0
30 - 39	3	30.0
40 - 49	1	10.0
50 - 59	1	10.0
60 - 69	0	0.0
70 - 79	2	20.0
80 - 89	1	10.0
90 -100	1	10.0

TABLE 8. FREQUENCY DISTRIBUTION OF THE PERCENT OF HOUSING CONSTRUCTED BEFORE 1950 FOR THE CENSUS TRACTS IN WHICH THE 68 SUBURBAN PUBLIC SCHOOLS WERE LOCATED

RANGE % OF PRE 1950 HOUSING	NUMBER OF SCHOOLS	% IN SCHOOLS
0 - 9	10	14.71
10 - 19	8	11.76
20 - 29	4	5.88
30 - 39	10	14.71
40 - 49	4	5.88
50 - 59	7	10.29
60 - 69	4	5.88
70 - 79	6	8.82
80 - 89	4	5.88
90 -100	11	16.17

TABLE 9. FREQUENCY DISTRIBUTION OF MEAN ANNUAL INCOME FOR CENSUS TRACT OF THE 131 CLEVELAND PUBLIC ELEMENTARY SCHOOLS

RANGE OF INCOME	NUMBER OF SCHOOLS	% OF SCHOOLS
2,000 - 3,999	2	1.53
4,000 - 5,999	11	8.40
6,000 - 7,999	20	15.27
8,000 - 9,999	44	33.59
10,000 -11,999	38	29.01
12,000 -13,999	13	9.92
14,000 -15,999	1	0.76
16,000 -17,999	2	1.53

TABLE 10. FREQUENCY DISTRIBUTION OF MEAN ANNUAL INCOME IN 43 ROMAN CATHOLIC ELEMENTARY SCHOOLS WITHIN THE CITY OF CLEVELAND

RANGE OF INCOME	NUMBER OF SCHOOLS	% OF SCHOOLS
2,000 - 3,999	0	0.0
4,000 - 5,999	1	2.32
6,000 - 7,999	3	6.97
8,000 - 9,999	13	30.23
10,000 -11,999	21	48.83
12,000 -13,999	5	11.62

TABLE 11. FREQUENCY DISTRIBUTION OF MEAN ANNUAL INCOME IN 10 LUTHERAN SCHOOLS IN CLEVELAND AND IN THE SUBURBS

RANGE OF INCOME	NUMBER OF SCHOOLS	% OF SCHOOLS
10,000 - 11,999	2	20
12,000 - 13,999	4	40
14,000 - 15,999	1	10
16,000 - 17,999	2	20
18,000 - 19,999	1	1

TABLE 12. FREQUENCY DISTRIBUTION OF MEAN ANNUAL INCOME FOR CENSUS TRACTS OF 68 PUBLIC ELEMENTARY SCHOOLS IN THE SUBURBS

RANGE OF INCOME	NUMBER OF SCHOOLS	% OF SCHOOLS
2,000 - 9,999	2	2.94
10,000 - 11,999	11	16.18
12,000 - 13,999	30	44.12
14,000 - 15,999	13	19.12
16,000 - 17,999	9	13.24
18,000 - 19,999	1	1.47
20,000 - 21,999	0	0.0
22,000 - 23,999	1	1.47
24,000 - 25,000	1	1.47

TABLE 13. FREQUENCY DISTRIBUTION OF THE PERCENT OF WHITE CHILDREN IN THE 130 ELEMENTARY SCHOOLS WITHIN THE CITY OF CLEVELAND AND 70 SCHOOLS WITHIN THE SUBURBS

	CLEVELAND PUBLIC SCHOOLS		SUBURBAN SCHOOLS	
RANGE OF % WHITE	NUMBER OF SCHOOLS	% OF SCHOOLS	NUMBER SCHOOL	% OF SCHOOLS
0-9	59	45.38	0	0.0%
10-19	1	0.77	1	1.4%
20-29	2	1.54	0	0.0%
30-39	2	1.54	2	2.9%
40-49	4	3.08	1	1.4%
50-59	3	2.31	0	0.0%
60-69	3	2.31	0	0.0%
70-79	5	3.85	2	2.9%
80-89	7	5.38	7	10.0%
90-94	13	10.00	0	0.0%
95-100	31	23.85	57	81.4%

TABLE 14. FREQUENCY DISTRIBUTION OF THE NUMBER OF INDUSTRIES WITHIN A HALF-MILE RADIUS OF ELEMENTARY SCHOOLS IN THE CLEVELAND PUBLIC AND PAROCHIAL SCHOOL SYSTEMS AND IN THE SUBURBAN SCHOOL SYSTEMS

Number Industries	Cleveland Public		Cleveland Parochial		Suburban Public	
	Number	Percent	Number	Percent	Number	Percent
0	28	21.1	15	28.8	54	76.1
1	31	23.3	12	23.1	12	16.9
2	19	14.3	5	9.6	3	4.2
3	14	10.5	5	9.6	1	1.4
4	9	6.8	3	5.8	1	1.4
5	8	6.0	3	5.8	0	0.0
6	9	6.8	3	5.8	0	0.0
7	5	3.8	2	3.8	0	0.0
8	2	1.5	2	3.8	0	0.0
9	0	0.0	0	0.0	0	0.0
10	1	0.8	0	0.0	0	0.0
11	0	0.0	0	0.0	0	0.0
12	2	1.5	0	0.0	0	0.0
13	1	0.8	1	1.9	0	0.0
14	1	0.8	0	0.0	0	0.0
15	2	1.5	1	1.9	0	0.0
22	1	0.8	0	0.0	0	0.0
TOTAL	133		52		71	

TABLE 15. PERCENT OF SAMPLES ABOVE THE MEAN AIR VALUE FOR THE 21 REPORTING AIR MONITORING STATIONS

Air Station	Particulate	Pb%	Cd%	Sb%	So2%
1	82.8	15.2	22.7	20.5	41.3
2	21.3	---	---	---	18.9
3	41.2	7.5	7.7	5.8	25.9
4	23.5	17.2	10.3	0.0	30.9
5	31.6	12.2	24.4	12.2	21.6
6	22.2	18.2	21.2	45.5	20.5
7	19.0	19.2	11.8	5.9	21.8
8	22.1	18.8	10.4	6.4	19.2
9	81.0	4.3	6.5	11.6	36.8
10	76.4	29.4	11.8	3.9	43.5
11	---	---	---	---	---
12	12.2	6.0	2.0	2.1	15.4
13	77.4	3.0	9.0	54.5	54.2
14	13.6	0.0	0.0	3.0	17.6
15	56.7	19.2	21.1	7.8	24.7
16	25.0	---	---	---	48.8
17	65.3	26.7	2.2	2.2	---
18	19.4	---	---	----	---
19	25.5	---	---	---	---
20	14.8	5.6	13.9	2.8	---
21	62.5	15.0	12.5	5.0	---

TABLE 16. TOTAL SUSPENDED PARTICULATE FROM AIR COLLECTING STATIONS IN CLEVELAND (PARTICULATE DATA FROM GEORGE CRAIG, CLEVELAND AIR POLLUTION CONTROL CENTER)

Air Station	Annual Arithmetic Mean ug/m3	Total Samples Analyzed	Number Samples 125 ug/m3	% Above 125 ug/m3
1	198	58	48	82.8
2	124	80	17	21.3
3	123	85	35	41.2
4	97	51	12	23.5
5	100	76	24	31.6
6	100	63	14	22.2
7	100	79	15	19.0
8	102	77	17	22.1
9	214	79	64	81.0
10	153	72	55	76.4
12	83	74	9	12.2
13	173	62	48	77.4
14	89	59	8	13.6
15	151	60	34	56.7
16	97	52	13	25.0
17	141	72	47	65.3
18	103	72	14	19.4
19	93	51	13	25.5
20	87	54	8	14.8
21	173	56	35	62.5
TOTAL	2501	1332	530	---

TABLE 17. PERCENT OCCURRENCE OF TESTS 2X THE ARITHMETIC MEAN OF ATMOSPHERIC LEAD FOR AIR STATIONS IN CLEVELAND. DATA ON LEAD IN SUSPENDED PARTICULATE WAS OBTAINED FROM DR. ROBERT B. KING AND CO-WORKERS OF THE LEWIS RESEARCH CENTER AND WERE USED BY US TO PREPARE THIS TABLE FOR 6/1/71 to 7/31/72.

Air Station	Annual Geometric Mean-ng/m^3	Samples Analyzed	Samples Over 1515 ng/m^3	% Samples Over 1515 ng/m^3
1	850.6	46	7	15.2
3	723.2	53	4	7.5
4	843.7	29	5	17.2
5	695.9	41	5	12.2
6	856.6	33	6	18.2
7	864.1	52	10	19.2
8	777.1	48	9	18.8
9	682.4	46	2	4.3
10	1,064.6	51	15	29.4
12	576.6	50	3	6.0
13	523.6	33	1	3.0
14	441.9	34	0	0.0
15	754.3	52	10	19.2
17	1,197.8	45	12	26.7
20	457.7	36	2	5.6
21	811.9	40	6	15.0
TOTAL	12,125.0	689	97	-
MEAN	757.8	43.1	6.06	14.1

TABLE 18. PERCENT OCCURRENCE OF 5 TIMES ANNUAL MEAN OF ATMOSPHERIC CADMIUM FOR AIR COLLECTING STATIONS IN CLEVELAND. DATA ON CADMIUM IN SUSPENDED PARTICULATE OBTAINED IN SURVEY BY ROBERT B. KING AND CO-WORKERS OF LEWIS RESEARCH CENTER WAS USED BY US TO PREPARE THIS TABLE (8/1/71 - 7/31/72)

Air Station	Annual Geometric Mean ng/m^3	Total Samples for Cd	Samples Over 19.5 ng/m^3	% Samples Over 19.5 ng/m^3
1	5.7	44	10	22.7%
3	3.2	52	4	7.7%
4	2.3	29	3	10.3%
5	4.7	41	10	24.4%
6	5.8	33	7	21.2%
7	4.0	51	6	11.8%
8	3.2	48	5	10.4%
9	3.4	46	3	6.5%
10	4.3	51	6	11.8%
12	1.7	50	1	2.0%
13	4.7	33	3	9.0%
14	1.8	34	0	0.0%
15	5.6	52	11	21.1%
17	3.9	45	1	2.2%
20	3.4	36	5	13.9%
21	4.3	40	5	12.5%
TOTAL	62.0	685	80	
MEAN	3.9	42.8	5.0	11.7

TABLE 19. PERCENT INCIDENCE OF 5X THE ANNUAL MEAN OF ATMOSPHERIC ANTIMONY FOR AIR COLLECTING STATIONS IN CLEVELAND. DATA ON ANTIMONY IN SUSPENDED PARTICULATE FROM THE SURVEY BY MR. ROBERT B. KING AND CO-WORKERS OF THE LEWIS RESEARCH CENTER OF NASA WAS USED BY US TO PREPARE THIS TABLE.

Air Station	Annual Geometric Mean ng/m^3	Total Tests for Sb	Tests Over 217 ng/m^3	% Tests Over 217 ng/m^3
1	47.0	44	9	20.5%
3	10.0	52	3	5.8%
4	19.0	28	0	0.0%
5	32.0	41	5	12.2%
6	110.0	33	15	45.5%
7	10.0	51	3	5.9%
8	9.6	47	3	6.4%
9	33.0	43	5	11.6%
10	19.0	51	2	3.9%
12	5.4	48	1	2.1%
13	310.0	33	18	54.5%
14	11.0	33	1	3.0%
15	18.0	51	4	7.8%
17	22.0	45	1	2.2%
20	13.0	36	1	2.8%
21	26.0	40	2	5.0%
TOTAL	695.0	676	73	
MEAN	43.4	42.3	4.6	10.8%

TABLE 20. MEAN OF TOOTH LEAD IN 11,207 CHILDREN ATTENDING CLEVELAND PUBLIC AND PAROCHIAL SCHOOLS, SUBURBAN SCHOOLS, HOSPITALS, AND MISCELLANEOUS SOURCES

School	Number Children	mg.Pb/100g. Mean	Standard Deviation	Variance
Cleveland Public	5,333	5.57	2.05	4.19
Parochial				
Roman Catholic	843	5.47	2.14	4.57
Lutheran	116	5.79	1.80	3.24
Suburbs				
I	1,602	5.17	2.13	4.52
II	51	5.19	1.58	2.51
III	134	6.54	2.54	6.43
IV	244	5.75	1.90	3.60
V	46	5.68	1.53	2.33
VI	298	4.85	2.10	4.40
VII	386	4.70	1.78	3.17
VIII	613	5.51	2.36	5.56
IX	330	5.70	1.99	3.94
Hospitals	1,085	6.13	2.63	6.91
Miscellaneous	126	5.95	2.15	4.61

TABLE 21. SUMMARY TO SHOW THE OCCURRENCE OF 8.0 MG OR MORE OF LEAD PER 100 GRAMS OF TOOTH TISSUE FROM 11,241 CHILDREN IN CLEVELAND, ITS SUBURBS AND EXURBS. THE HOSPITAL GROUP INCLUDES TEETH EXTRACTED FROM CHILDREN LIVING IN CLEVELAND.

School System	Number Tested	Children 8.0+ mg Pb	% 8.0+ mg Pb
CLEVELAND			
Public	5,367	712	13.3%
Catholic	854	91	10.7%
Lutheran	105	21	20.0%
TOTAL	6,326	824	
% OCCURRENCE			13.0%
SUBURBS			
I	1,602	194	12.1%
III	134	37	27.6%
IV	244	30	12.3%
V	46	6	13.0%
VI	298	26	8.7%
VII	386	20	5.2%
VIII	613	90	14.7%
IX	330	57	17.3%
TOTAL	3,653	460	
% OCCURRENCE			12.6%
EXURBS	177	28	15.8%
HOSPITALS	1,085	236	21.8%

TABLE 22. PERCENT OCCURRENCE OF LEAD IN SHED TEETH OF CHILDREN LIVING IN CLEVELAND AND ATTENDING THE CLEVELAND PUBLIC SCHOOLS. THE NUMBER OF TEETH ALSO REPRESENTS THE NUMBER OF CHILDREN TESTED FOR ACCUMULATED LEAD.

Tooth Type + Part	Number Teeth	0 - 4.9	5 - 7.9	8+
Incisor Crowns without cavities or fillings	3,911	39.2	45.6	15.2
Molar Crowns without cavities or fillings	914	60.1	35.7	4.3
Molar Crowns with cavities and/or fillings	225	48.0	42.7	9.3
Incisor Roots with and without cavities and/or fillings	99	28.3	52.5	19.2
Molar Roots with and without cavities and/or fillings	54	31.5	50.0	18.5
TOTAL	5,203			
% OCCURRENCE (ALL CHILDREN)		43.0	43.9	13.1

TABLE 23. PERCENT OCCURRENCE OF LEAD IN SHED TEETH OF CHILDREN LIVING IN CLEVELAND AND ATTENDING CLEVELAND CATHOLIC SCHOOLS. THE NUMBER OF TEETH ALSO REPRESENTS THE NUMBER OF CHILDREN TESTED FOR ACCUMULATED LEAD.

		PERCENT OCCURRENCE OF LEAD IN MG/100G		
Tooth Type + Part	Number Teeth	0 - 4.9	5 - 7.9	8+
Incisor Crowns without cavities or fillings	620	45.0	42.1	12.9
Molar Crowns without cavities or fillings	145	56.6	36.6	6.9
Molar Crowns with cavities and/or fillings	51	66.7	31.4	2.0
Incisor Roots with and without cavities and/or fillings	6	50.0	50.0	0.0
Molar Roots with and without cavities and/or fillings	6	83.3	16.7	0.0
TOTAL	828			
% OCCURRENCE (ALL CHILDREN)		48.67	40.35	11.0

TABLE 24. PERCENT OCCURRENCE OF LEAD IN SHED TEETH OF CHILDREN LIVING IN CLEVELAND AND ATTENDING CLEVELAND LUTHERAN SCHOOLS. THE NUMBER OF TEETH ALSO REPRESENTS THE NUMBER OF CHILDREN TESTED FOR ACCUMULATED LEAD.

		PERCENT OCCURRENCE OF LEAD IN MG/100G		
Tooth Type + Part	Number Teeth	0 - 4.9	5 - 7.9	8+
Incisor Crowns without cavities or fillings	83	34.9	44.6	20.5
Molar Crowns without cavities or fillings	21	52.4	33.3	14.3
Molar Crowns with cavities and/or fillings	8	37.5	62.5	0.0
Incisor Roots with with and without cavities and/or fillings	1	0.0	0.0	100.0
Molar Roots with and without cavities and/or fillings	1	100.0	0.0	0.0
TOTAL	114			
% OCCURRENCE (ALL CHILDREN)		37.7	43.0	18.4

TABLE 25. PERCENT OCCURRENCE OF LEAD IN SHED TEETH OF CHILDREN LIVING IN SUBURBS OF CLEVELAND. THE NUMBER OF TEETH ALSO REPRESENTS THE NUMBER OF CHILDREN TESTED FOR ACCUMULATED LEAD

	Number	Percent occurrence of lead in mg/100g		
Tooth Type + Part	Teeth	0 - 4.9	5 -7.9	8+
Incisor Crowns without cavities or fillings	2,854	42.1	42.4	15.5
Molar Crowns without cavities or fillings	435	62.9	33.9	3.2
Molar Crowns with cavities and/or fillings	203	56.5	32.5	11.0
Incisor Roots with and without cavities and/or fillings	42	53.5	23.0	23.6
Molar Roots with and without cavities and/or fillings	43	54.5	43.0	2.3
TOTAL	3,577			
% OCCURRENCE (ALL CHILDREN)		36.2	42.3	21.6

TABLE 26. PERCENT OCCURRENCE OF LEAD IN SHED AND EXTRACTED TEETH OF CHILDREN IN INSTITUTIONS OR TREATED AT 5 DENTAL CLINICS IN CLEVELAND. THE NUMBER OF TEETH REPRESENTS THE NUMBER OF CHILDREN TESTED

Tooth Type + Part	Number Teeth	Percent occurrence of lead in mg/100g 0 - 4.9	5 - 7.9	8+
Incisor Crowns without cavities and/or fillings	165	43.0	41.8	15.2
Molar Crowns without cavities and/or fillings	157	50.4	40.6	9.1
Molar Roots	547	30.0	43.0	27.1
TOTAL	869			
% OCCURRENCE (ALL CHILDREN)		36.2	42.3	21.6

TABLE 27. PERCENT OCCURRENCE OF AMOUNTS OF LEAD IN SHED INCISOR CROWNS OF TEETH NOT HAVING CAVITIES AND/OR FILLINGS FOR CLEVELAND PUBLIC SCHOOLS.

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
X- 2	20	55.0	30.0	15.0
X- 3	32	21.9	43.8	34.4
X- 4	35	34.3	57.1	8.6
X- 5	39	51.3	35.9	12.8
X- 6	84	59.5	34.5	6.0
X- 7	19	36.8	42.1	21.1
X- 8	23	43.5	52.2	4.3
X- 9	73	50.7	32.9	16.4
X-10	29	41.4	55.2	3.4
X-11	38	28.9	52.6	18.4
X-12	36	41.7	44.4	13.9
X-13	25	60.0	32.0	8.0
X-14	28	32.1	67.9	0.0
X-15	94	35.1	52.1	12.8
X-16	38	52.6	34.2	13.2
X-17	13	38.5	38.5	23.1
X-18	34	38.2	47.1	14.7
X-19	40	50.0	37.5	12.5
X-20	26	53.8	30.8	15.4

TABLE 27 (CONTINUED)

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
X-21	12	33.3	25.0	41.7
X-22	57	56.1	38.6	5.3
X-23	27	55.6	37.0	7.4
X-24	5	100.0	0.0	0.0
X-25	35	42.9	42.9	14.3
X-26	24	29.2	58.3	12.5
X-27	5	60.0	40.0	0.0
X-28	25	52.0	40.0	8.0
X-29	14	57.1	35.7	7.1
X-30	20	25.0	30.0	45.0
X-31	37	35.1	56.8	8.1
X-32	19	21.1	42.1	36.8
X-33	15	66.7	26.7	6.7
X-34	29	24.1	51.7	24.1
X-35	66	42.4	36.4	21.2
X-36	26	61.5	26.9	11.5
X-37	9	33.3	44.4	22.2
X-38	27	40.7	48.1	11.1
X-39	18	38.9	55.6	5.6
X-40	63	17.5	65.1	17.5

continued on next page.

TABLE 27 (CONTINUED)

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb 100g	8.0 + mg Pb
Cleveland Public				
X-41	18	0.0	77.8	22.2
X-42	17	41.2	52.9	5.9
X-43	16	6.3	68.8	25.0
X-44	9	11.1	77.8	11.1
X-45	35	77.1	20.0	2.9
X-46	15	46.7	46.7	6.7
X-47	14	35.7	35.7	28.6
X-48	30	66.7	33.3	0.0
X-49	26	46.2	38.5	15.4
X-50	36	44.4	41.7	13.9
X-51	39	30.8	59.0	10.3
X-52	13	15.4	84.6	0.0
X-53	42	42.9	40.5	16.7
X-54	21	28.6	52.4	19.0
X-56	66	12.1	60.6	27.3
X-57	34	44.1	47.1	8.8
X-58	44	43.2	50.0	6.8
X-59	20	45.0	35.0	20.0
X-60	28	50.0	39.3	10.7

continued on next page.

TABLE 27 (CONTINUED)

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
Cleveland Public				
X-61	25	36.0	44.0	20.0
X-62	11	36.4	27.3	36.4
X-63	38	21.1	55.3	23.7
X-66	5	60.0	20.0	20.0
X-67	16	25.0	62.5	12.5
X-68	19	57.9	26.3	15.8
X-69	23	21.7	60.9	17.4
X-70	40	77.5	17.5	5.0
X-71	40	30.0	55.0	15.0
X-72	40	35.0	57.5	7.5
X-73	42	21.4	54.8	23.8
X-74	18	55.6	33.3	11.1
X-75	6	33.3	50.0	16.7
X-76	44	45.5	43.2	11.4
X-77	9	55.6	33.3	11.1
X-78	36	25.0	66.7	8.3
X-79	31	61.3	29.0	9.7
X-80	1	0.0	100.0	0.0

continued on next page.

TABLE 27 (CONTINUED)

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
Cleveland Public				
X-81	28	28.6	50.0	21.4
X-82	32	31.3	56.3	12.5
X-84	59	15.3	50.8	33.9
X-85	22	31.8	45.5	22.7
X-86	21	19.0	57.1	23.8
X-88	18	11.1	72.2	16.7
X-89	62	29.0	51.6	19.4
X-90	24	25.0	45.8	29.2
X-91	29	10.3	58.6	31.0
X-92	9	55.6	44.4	0.0
X-93	46	17.4	60.9	21.7
X-94	15	20.0	66.7	13.3
X-95	27	74.1	22.2	3.7
X-96	20	50.0	45.0	5.0
X-97	55	29.1	58.2	12.7
X-98	30	33.3	56.7	10.0
X-99	25	32.0	56.0	12.0
X-100	22	36.4	50.0	13.6

continued on next page.

TABLE 27 (CONTINUED)

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
X-101	24	25.0	62.5	12.5
X-102	79	60.8	35.4	3.8
X-103	1	100.0	0.0	0.0
X-104	40	42.5	45.0	12.5
X-105	39	43.6	43.6	12.8
X-106	63	44.4	39.7	15.9
X-107	11	18.2	54.5	27.3
X-108	53	47.2	28.3	24.5
X-109	12	66.7	25.0	8.3
X-110	14	50.0	28.6	21.4
X-111	12	25.0	58.3	16.7
X-112	19	31.6	42.1	26.3
X-113	12	50.0	50.0	0.0
X-114	40	45.0	42.5	12.5
X-115	36	22.2	55.6	22.2
X-116	36	44.4	41.7	13.9
X-117	22	40.9	45.5	13.6
X-118	33	42.4	42.4	15.2
X-119	78	39.7	51.3	9.0
X-120	19	57.9	36.8	5.3

continued on next page.

TABLE 27 (CONTINUED)

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
X-121	52	34.6	38.5	26.9
X-122	33	42.4	33.3	24.2
X-123	41	51.2	41.5	7.3
X-124	27	14.8	44.4	40.7
X-125	53	73.6	24.5	1.9
X-126	51	29.4	43.1	27.5
X-128	38	23.7	57.9	18.4
X-129	39	17.9	51.3	30.8
X-130	6	50.0	50.0	0.0
X-131	32	37.5	40.6	21.9
X-132	17	17.6	64.7	17.6
X-133	7	28.6	71.4	0.0
X-134	39	28.2	48.7	23.1
X-135	15	33.3	60.0	6.7
TOTAL:	3,911			
% INCIDENCE (All children)		39.2	45.6	15.2

TABLE 28. PERCENT OCCURRENCE OF AMOUNTS OF LEAD IN SHED INCISOR CROWNS OF TEETH NOT HAVING CAVITIES AND/OR FILLINGS FROM CHILDREN IN THE CLEVELAND PAROCHIAL SCHOOLS.

School	Number Teeth	0 - 4.9 mg Pb/100 g	5 - 7.9 mg Pb/100 g	8.0+ mg Pb/100g
XI- 1	18	38.9	33.3	27.8
XI- 2	2	50.0	50.0	0.0
XI- 3	83	45.8	45.8	8.4
XI- 4	53	37.7	43.4	18.9
XI- 5	7	42.9	57.1	0.0
XI- 6	25	20.0	56.0	24.0
XI- 7	22	22.7	68.2	9.1
XI- 8	13	30.8	38.5	30.8
XI- 9	9	77.8	11.1	11.1
XI-10	3	66.7	33.3	0.0
XI-11	31	54.8	29.0	16.1
XI-12	31	42.2	51.6	3.2
XI-13	7	42.9	57.1	0.0
XI-14	17	35.3	41.2	23.5
XI-15	15	40.0	46.7	13.3
XI-16	8	37.5	12.5	50.0
XI-17	17	47.1	41.2	11.8
XI-18	18	66.7	33.3	0.0
XI-19	2	0.0	100.0	0.0
XI-20	19	26.3	63.2	10.5

TABLE 28 (CONTINUED)

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb/100g
XI-21	6	66.7	16.7	16.7
XI-22	11	9.1	81.8	9.1
XI-23	11	27.3	45.5	27.3
XI-24	14	64.3	21.4	14.3
XI-25	4	25.0	50.0	25.0
XI-26	12	66.7	33.3	0.0
XI-27	11	45.5	54.5	0.0
XI-28	10	60.0	40.0	0.0
XI-29	1	0.0	0.0	100.0
XI-30	5	20.0	80.0	0.0
XI-31	7	28.6	57.1	14.3
XI-32	14	42.9	50.0	7.1
XI-33	11	45.5	45.5	9.1
XI-34	33	60.6	21.2	18.2
XI-35	1	100.0	0.0	0.0
XI-36	1	100.0	0.0	0.0
XI-37	15	73.3	26.7	0.0
XI-38	8	75.0	12.5	12.5
XI-39	9	66.7	33.3	0.0
XI-40	5	60.0	40.0	0.0
XI-41	9	33.3	44.4	22.2
XI-42	10	60.0	30.0	10.0
XI-43	12	41.7	33.3	25.0
TOTAL	620			

TABLE 29. PERCENT OCCURRENCE OF AMOUNTS OF LEAD IN SHED INCISOR CROWNS WITHOUT CAVITIES AND/OR FILLINGS IN LUTHERAN SCHOOLS OF CLEVELAND AND ITS SUBURBS. THE ASTERISK INDICATES LUTHERAN SCHOOLS IN SUBURBS OR EXURBS

School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb/100g
*XII- 1	13	30.8	69.2	0.0
XII- 2	18	72.2	22.2	5.6
XII- 3	9	33.3	55.6	11.1
XII- 4	11	36.4	18.2	45.5
*XII- 5	7	28.6	28.6	42.9
*XII- 6	14	0.0	50.0	50.0
*XII- 7	3	33.3	66.7	0.0
XII- 8	1	0.0	100.0	0.0
*XII- 9	7	28.6	71.4	0.0
TOTAL	83			
% OCCURRENCE		34.9	44.6	20.5

TABLE 30. PERCENT OCCURRENCE OF LEAD IN SHED INCISOR CROWNS OF TEETH WHICH DID NOT HAVE A CAVITY AND/OR A FILLING IN 2,854 CHILDREN IN 8 CLEVELAND SUBURBS. THE COLUMN "NUMBER OF TEETH" ALSO REPRESENTS THE NUMBER OF CHILDREN TESTED FOR ACCUMULATED LEAD

School	Number Teeth	Percent occurrence of lead in mg/100g tooth tissue		
		0 - 4.9	5 - 7.9	8+
I	1,238	48.4	36.9	14.7
III	110	23.6	43.6	32.7
IV	196	34.7	52.6	12.8
V	33	24.2	60.6	15.2
VI	212	58.0	31.6	10.4
VII	307	59.6	34.9	5.5
VIII	490	44.7	39.2	16.1
IX	268	43.6	39.8	16.7
TOTAL	2,854			
% OCCURRENCE		42.1	42.4	15.5

TABLE 31. PERCENT OCCURRENCE OF AMOUNTS OF LEAD IN SHED INCISOR CROWNS WITHOUT CAVITIES AND /OR FILLINGS IN THE SCHOOLS OF SUBURB I PUBLIC SCHOOL SYSTEM

Suburb and School	Number Teeth	% Occurrence of amounts of tooth lead (mg/100g) 0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
I- I	68	30.9	47.1	22.1
I- II	24	83.3	16.7	0.0
I- III	50	44.0	44.0	12.0
I- IV	59	47.5	39.0	13.6
I- V	94	27.7	50.0	22.3
I- VI	68	57.4	23.5	19.1
I- VII	56	50.0	39.3	10.7
I-VIII	73	54.8	31.5	13.7
I- IX	34	64.7	23.5	11.8
I- X	75	36.0	41.3	22.7
I- XI	10	30.0	60.0	10.0
I- XII	36	30.6	41.7	27.8
I-XIII	64	57.8	25.0	17.2
I- XIV	88	36.4	54.5	9.1
I- XV	81	59.3	25.9	14.8
I- XVI	31	80.6	12.9	6.5
I-XVII	64	56.3	35.9	7.8

TABLE 31 (CONTINUED)

Suburb and School	Number Teeth	% Occurrence of amounts of tooth lead (mg/100g)		
		0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
I-XVIII	74	52.7	33.8	13.5
I- XIX	50	46.0	32.0	22.0
I- XX	63	42.9	46.0	11.1
I- XXI	76	59.2	34.2	6.6
TOTAL	1,238			
% OCCURRENCE		48.4	36.9	14.7

TABLE 32. PERCENT OCCURRENCE OF AMOUNTS OF LEAD IN SHED INCISOR CROWNS WITHOUT CAVITIES AND/OR FILLINGS

Suburb and School	Number Teeth	% Occurrence of amounts of tooth lead (mg/100g)		
		0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb/100g
SUBURB III				
III- 1	63	22.2	46.0	31.7
III- 2	47	25.5	40.4	34.0
TOTAL	110			
% OCCURRENCE		23.9	43.2	32.9
SUBURB IV				
IV - 1	34	44.1	38.2	17.6
IV - 2	41	41.5	56.1	2.4
IV - 3	66	40.9	51.5	7.6
IV - 4	49	18.4	55.1	26.5
IV - 5	6	0.0	100.0	0.0
TOTAL	196			
% OCCURRENCE		32.7	52.6	12.8
SUBURB V				
V - 1	33	24.2	60.6	15.2
TOTAL	33			
% OCCURRENCE		24.2	60.6	15.2

TABLE 32 (CONTINUED)

Suburb and School	Number Teeth	% Occurrence of amounts of tooth lead (mg/100g) 0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb/100g
SUBURB VI				
VI - 1	56	76.8	14.3	8.9
VI - 2	36	63.9	27.8	8.3
VI - 3	53	37.7	49.1	13.2
VI - 4	30	56.7	36.7	6.7
VI - 5	27	51.9	33.3	14.8
VI - 6	10	60.0	30.0	10.0
TOTAL	212			
% OCCURRENCE		58.0	31.6	10.4

TABLE 33. PERCENT OCCURRENCE OF AMOUNTS OF LEAD IN SHED INCISOR CROWNS WITHOUT CAVITIES AND/OR FILLINGS

		% Occurrence of amounts of tooth lead (mg/100g)		
Suburb and School	Number Teeth	0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pt
SUBURB VII				
VII- 1	40	57.5	37.5	5.0
VII- 2	33	48.5	45.5	6.1
VII- 3	26	73.1	23.1	3.8
VII- 4	49	28.6	65.3	6.1
VII- 5	18	61.1	27.8	11.1
VII- 6	24	70.8	25.0	4.2
VII- 7	35	65.7	25.7	8.6
VII- 8	30	86.7	13.3	0.0
VII- 9	32	62.5	31.3	6.3
VII-10	18	77.8	16.7	5.6
VII-11	2	0.0	100.0	0.0
TOTAL:	307			
% OCCURRENCE		59.6	34.9	5.5

TABLE 34. PERCENT OCCURRENCE OF AMOUNTS OF LEAD IN SHED INCISOR CROWNS WITHOUT CAVITIES AND/OR FILLINGS

Suburb and School	Number Teeth	% Occurrence of amounts of tooth lead (mg/100g) 0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
SUBURB VIII				
VIII- 1	63	27.0	52.4	20.6
VIII- 2	15	60.0	26.7	13.3
VIII- 3	57	75.4	21.1	3.5
VIII- 4	49	46.9	34.7	18.4
VIII- 5	81	32.1	43.2	24.7
VIII- 6	23	52.2	34.8	13.0
VIII- 7	61	49.2	41.0	9.8
VIII- 8	46	45.7	43.5	10.9
VIII- 9	39	46.2	28.2	25.6
VIII-10	56	35.7	48.2	16.1
TOTAL:	490			
% OCCURRENCE		44.7	39.2	16.1

TABLE 35. PERCENT OCCURRENCE OF LEAD IN SHED INCISOR CROWNS WITHOUT CAVITIES AND/OR FILLINGS

Suburb and School	Number Teeth	% Occurrence of amounts of tooth lead (mg/100g) 0 - 4.9 mg Pb/100g	5 - 7.9 mg Pb/100g	8.0 + mg Pb
SUBURB IX				
IX- 1	22	77.3	9.1	13.6
IX- 2	15	46.7	46.7	6.7
IX- 3	28	32.1	50.0	17.9
IX- 4	17	16.5	23.5	0.0
IX- 5	18	44.1	38.9	16.7
IX- 6	15	40.0	26.7	33.3
IX- 7	15	46.7	53.3	0.0
IX- 8	30	13.3	66.7	20.0
IX- 9	54	5.6	61.1	33.3
IX-10	54	51.9	22.2	25.9
TOTAL:	268			
% OCCURRENCE		43.4	39.8	16.7

TABLE 36. PERCENT FREQUENCIES OF TOOTH LEAD IN CHILDREN WHO LIVED 80 TO 100% AND 79% OR LESS OF THEIR LIFE AT RESIDENCE WHERE LIVING WHEN TOOTH WAS SHED

Tooth Lead mg/100g	Lifespan	Percent incidence according to age when tooth was shed or extracted. -5	5	6	7	8	9	10	11	12+	% Total
1.0 - 1.9	80+%	-	15.8	21.1	21.1	15.8	15.8	5.3	5.3	-	0.5%
	-79%	19.0	-	14.3	9.5	14.3	9.5	9.5	9.5	14.3	0.3%
2.0 - 2.9	80+%	-	9.0	22.1	13.1	7.5	11.6	22.6	12.6	1.5	5.1%
	-79%	8.7	4.3	11.6	12.8	15.1	17.4	15.7	9.6	4.9	4.7%
3.0 - 3.9	80+%	0.2	7.5	20.9	15.9	14.0	15.1	15.6	10.0	0.9	16.3%
	-79%	11.7	3.9	14.6	13.3	13.8	16.5	15.1	7.4	3.8	15.0%
4.0 - 4.9	80+%	0.1	7.0	23.8	21.0	12.8	11.2	15.8	6.4	1.9	24.0%
	-79%	10.8	5.4	18.1	15.3	13.4	13.9	12.2	7.3	3.5	25.2%
5.0 - 5.9	80+%	0.3	12.1	29.9	22.6	11.4	8.4	9.5	5.1	0.7	18.8%
	-79%	11.0	7.4	20.4	19.4	11.8	11.9	10.8	5.2	2.2	19.0%
6.0 - 6.9	80+%	1.3	13.9	32.9	22.5	8.9	6.9	8.6	3.2	1.8	15.1%
	-79%	13.0	8.3	22.9	19.7	13.3	9.1	7.6	4.0	2.1	15.3%
7.0 - 7.9	80+%	-	15.0	38.0	19.9	9.8	7.5	6.0	3.4	0.4	6.8%
	-79%	12.1	9.8	25.8	18.7	13.5	6.4	6.2	5.6	1.9	6.6%

TABLE 36 (CONTINUED)

Tooth Lead mg/100g	Lifespan	-5	5	6	7	8	9	10	11	12+	% Total
		Percent incidence according to age when tooth was shed or extracted.									
8.0 - 8.9	80+%	1.2	24.5	36.2	19.5	9.7	3.9	3.1	1.6	0.4	6.5%
	-79%	12.5	13.2	28.8	17.5	10.2	6.5	5.6	3.3	2.5	7.1%
9.0 - 9.9	80+%	1.8	25.9	38.4	22.3	4.5	0.9	2.7	3.6	-	2.8%
	-79%	12.5	17.9	28.6	15.5	9.5	6.5	3.6	5.4	0.6	2.3%
10.0 - 10.9	80+%	-	28.6	38.1	20.2	6.0	4.8	1.2	-	1.2	2.1%
	-79%	16.6	16.0	30.7	18.4	8.0	3.7	3.7	1.8	1.2	2.2%
11.0 - 11.9	80+%	-	30.4	43.5	8.7	17.4	-	-	-	-	0.6%
	-79%	7.5	7.5	37.5	20.0	10.0	10.0	2.5	2.5	2.5	0.5%
12.0 - 12.9	80+%	-	12.0	52.0	20.0	12.0	-	4.0	-	-	0.6%
	-79%	15.1	9.4	20.8	15.1	18.9	5.7	3.8	1.9	9.4	0.7%
13.0 +	80+%	3.3	20.0	46.7	13.3	10.0	6.7	-	-	-	0.8%
	-79%	9.7	15.3	30.6	11.1	11.1	6.9	4.2	6.9	4.2	1.0%
Total 80% + No.		18	479	1,130	787	437	369	445	224	46	3,935
Total 80% + No. %		0.5	12.2	28.7	20.0	11.1	9.4	11.3	5.7	1.2	-
Total 79 - % No.		847	545	1,495	1,223	934	859	758	430	215	7,306
Total 79 - No. %		11.6	7.5	20.5	16.7	12.8	11.8	10.4	5.9	2.9	-

TABLE 37. PEARSON COEFFICIENTS OF CORRELATION OF AGE AT TIME OF TOOTH LOSS AND THE AMOUNT OF LEAD IN TEETH OF CHILDREN LIVING IN SUBURBS AND CLEVELAND. THE HOSPITAL GROUP INCLUDED CHILDREN IN INSTITUTIONS AND CHILDREN WHOSE TEETH WERE EXTRACTED AT THE DENTAL CLINICS OF FIVE HOSPITALS WITHIN CLEVELAND THE NUMBER REPRESENTS THE NUMBER OF CHILDREN

	Correlation	Number	Significance
Suburban School Systems			
I	- .3710	1,487	.001
II	- .4445	43	.001
III	- .1453	128	.051
IV	- .2292	223	.001
V	- .5326	46	.001
VI	- .2803	289	.001
VII	- .1809	376	.001
VIII	- .3074	575	.001
IX	- .4399	325	.001
Cleveland Public Schools	- .2392	4,949	.001
Parochial Schools			
Lutheran	- .2377	116	.005
Roman Catholic	- .2799	786	.001
Hospitals	.0206	1,007	.256
Other	- .2306	122	.005

TABLE 38. SPEARMAN COEFFICIENTS OF CORRELATION OF AGE AT TIME OF TOOTH LOSS AND AMOUNT OF LEAD IN TEETH OF CHILDREN LIVING IN SUBURBS AND CLEVELAND; THE HOSPITAL GROUP INCLUDED CHILDREN IN INSTITUTIONS AND CHILDREN WHOSE TEETH WERE EXTRACTED AT THE DENTAL CLINICS OF 5 HOSPITALS WITHIN CLEVELAND. THE "NUMBER" COLUMN ALSO REPRESENTS THE NUMBER OF CHILDREN

Suburban School Systems	Correlation	Number	Significance
I	- .4034	1,487	.001
II	- .3087	43	.002
III	- .1852	128	.018
IV	- .2284	223	.001
V	- .5396	46	.001
VI	- .3217	289	.001
VII	- .1690	376	.001
VIII	- .3142	575	.001
IX	- .4591	325	.001

TABLE 39. PERCENT FREQUENCY DISTRIBUTION OF TOOTH LEAD BY AGE FOR 2,120 BOYS AND 2,799 GIRLS IN THE CLEVELAND PUBLIC SCHOOL SYSTEM. THE NUMBER OF TEETH ALSO REPRESENTS THE NUMBER OF CHILDREN

Amount of lead in mg Pb/100g.

Age	Sex	-1.0 - 4.9		5.0 - 7.9		8.0+		Total	
		No.	%	No.	%	No.	%	No.	%
5	Boys	56	27.9	89	44.3	56	27.8	201	9.5
5	Girls	86	27.3	151	47.9	78	24.7	315	11.2
6	Boys	167	30.1	287	51.8	100	18.0	554	26.1
6	Girls	259	36.6	323	45.7	125	17.7	707	25.3
7	Boys	181	38.4	218	46.3	72	15.3	471	22.2
7	Girls	181	35.3	265	51.7	67	13.0	513	18.3
8	Boys	129	45 5	126	44.4	29	10.2	284	13.4
8	Girls	181	35.3	164	42.8	38	9.2	383	13.7
9-12	Boys	368	60.3	210	34.4	32	5.2	610	28.8
9-12	Girls	500	56.8	335	38.0	46	5.2	881	31.5
Total Boys		901	42.5	930	43.9	289	13.6	2,120	
Total Girls		1207	43.1	1228	44.2	354	12.6	2,799	

TABLE 40. PERCENT FREQUENCY DISTRIBUTION OF TOOTH LEAD BY AGE FOR 710 BOYS AND 771 GIRLS IN SUBURB I PUBLIC SCHOOL SYSTEM. THE NUMBER OF TEETH ALSO REPRESENTS THE NUMBER OF CHILDREN

		Amount of Lead in mg Pb/100g.							
Age	Sex	-1.0 - 4.9		5.0 - 7.9		8.0+		Total	
		No.	%	No.	%	No.	%	No.	%
5	Boys	24	34.8	27	39.1	18	26.1	69	9.7
5	Girls	30	33.3	40	44.4	20	22.2	90	11.7
6	Boys	73	34.4	94	44.3	45	21.2	212	30.0
6	Girls	92	41.6	82	37.1	47	21.3	221	28.7
7	Boys	64	47.4	60	44.4	11	8.1	135	19.0
7	Girls	66	49.3	52	38.8	16	11.9	134	17.4
8	Boys	48	59.3	27	33.3	6	7.4	81	11.4
8	Girls	58	73.4	13	16.5	8	10.1	79	10.2
9-12	Boys	173	81.2	37	17.4	3	1.4	213	30.0
9-12	Girls	194	78.5	47	19.0	6	2.4	247	32.0
Total	Boys	382	53.8	245	34.5	83	11.7	710	
Total	Girls	440	57.0	234	30.4	97	12.6	771	

TABLE 41. SUMMARY OF HRISK, RACIAL, ECON., HWAY, AND IND. FOR 135 PUBLIC ELEMENTARY SCHOOLS IN THE CLEVELAND PUBLIC SCHOOL SYSTEM

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
X- 1	89.0	45.0	10.9	116.0	6
X- 2	88.6	59.2	10.9	134.5	1
X- 3	88.6	3.8	10.9	117.0	6
X- 4	92.8	0.3	9.1	71.9	1
X- 5	90.0	100.0	10.8	0.0	1
X- 6	78.5	93.4	11.2	13.5	2
X- 7	98.0	0.2	12.6	13.5	0
X- 8	85.4	0.0	4.2	0.0	2
X- 9	97.7	98.7	10.2	58.0	1
X-10	89.5	100.0	9.4	35.1	1
X-11	100.0	0.4	-	22.6	2
X-12	44.7	92.5	11.2	32.2	0
X-13	97.2	91.3	9.3	64.4	3
X-14	44.9	1.3	11.1	26.8	0
X-15	52.2	98.0	11.4	41.0	1
X-16	98.9	0.1	7.3	35.5	4
X-17	97.3	0.9	9.4	39.1	2
X-18	35.9	38.0	12.4	49.4	2
X-19	97.0	86.1	9.1	51.0	3
X-20	97.0	0.0	9.0	36.8	1

TABLE 41 (CONTINUED)

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
X-21	98.4	74.3	10.0	0.0	16
X-22	97.3	0.3	9.5	77.7	1
X-23	81.7	0.0	12.1	0.0	1
X-24	89.0	0.0	5.4	57.7	3
X-25	63.1	0.0	5.3	22.6	3
X-26	94.0	0.0	9.4	0.0	0
X-27	44.9	0.3	11.1	0.0	0
X-28	99.1	89.5	9.0	51.3	4
X-29	97.2	0.0	7.2	0.0	1
X-30	97.3	0.5	9.5	30.5	0
X-31	51.4	0.8	11.9	0.0	0
X-32	97.6	0.2	5.3	0.0	12
X-33	94.1	0.0	7.6	0.0	0
X-34	83.2	98.4	10.7	88.6	3
X-35	81.7	97.0	9.4	29.0	1
X-36	74.5	0.0	3.4	0.0	1
X-37	98.5	0.2	7.9	0.0	0
X-38	54.1	97.9	12.9	8.4	0
X-39	97.5	0.8	5.1	66.3	15
X-40	97.5	4.2	9.5	57.0	6

TABLE 41 (CONTINUED)

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
X-41	83.5	90.7	10.3	82.7	1
X-42	99.6	42.3	10.1	0.0	8
X-43	78.6	0.5	11.1	13.5	0
X-44	15.4	0.0	16.2	0.0	0
X-45	71.5	75.5	10.3	16.0	4
X-46	97.9	0.8	9.2	36.8	1
X-47	84.7	93.9	10.6	123.0	3
X-48	97.9	99.1	9.4	0.0	1
X-49	44.7	97.5	11.2	62.2	2
X-50	54.1	97.8	12.9	52.6	0
X-51	99.3	0.5	6.6	103.3	8
X-52	99.5	0.5	6.6	0.0	6
X-53	98.4	95.5	10.0	37.5	3
X-54	97.5	92.2	10.2	87.5	6
X-55	65.2	0.0	13.8	26.5	0
X-56	99.1	99.0	11.0	93.2	1
X-57	78.6	96.2	11.1	83.0	6
X-58	98.0	99.7	9.8	21.2	3
X-59	76.3	2.9	16.9	120.4	1
X-60	97.0	0.0	9.0	36.7	1

TABLE 41 (CONTINUED)

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
X-61	90.8	29.6	10.2	38.0	1
X-62	22.3	46.5	4.6	133.4	14
X-63	99.6	58.2	9.6	0.0	7
X-64	89.0	0.0	5.4	0.0	1
X-65	95.3	0.0	9.8	55.6	2
X-66	95.6	0.0	6.6	36.9	2
X-67	99.0	1.0	5.9	0.0	12
X-68	96.7	0.0	6.6	0.0	2
X-69	98.9	0.7	8.2	0.0	0
X-70	98.2	69.6	7.8	81.1	10
X-71	94.0	0.0	8.9	53.9	1
X-72	90.1	94.0	10.3	173.9	2
X-73	97.1	96.1	9.3	107.8	6
X-74	46.5	71.4	9.9	54.3	0
X-75	3.0	0.0	8.3	0.0	1
X-76	81.7	96.6	11.1	39.7	1
X-77	97.2	0.7	7.2	0.0	0
X-78	81.7	96.1	12.1	160.0	1
X-79	98.1	0.2	5.0	103.3	16
X-80	36.1	0.0	4.7	0.0	6

TABLE 41 (CONTINUED)

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
X- 81	70.9	98.8	12.6	24.8	1
X- 82	96.7	0.7	6.6	0.0	5
X- 83	99.3	0.6	6.9	0.0	0
X- 84	71.2	98.2	11.6	67.1	2
X- 85	76.5	90.2	10.3	55.3	3
X- 86	83.9	97.9	11.1	100.8	1
X- 87	98.8	29.0	9.4	118.4	5
X- 88	98.2	0.1	9.1	0.0	2
X- 89	98.3	93.8	9.3	108.0	1
X- 90	67.7	0.5	10.3	13.6	0
X- 91	97.2	99.1	9.3	40.3	2
X- 92	96.3	0.6	10.4	61.7	0
X- 93	91.6	0.4	8.6	100.8	0
X- 94	99.1	72.0	9.5	76.6	3
X- 95	72.0	94.0	12.1	68.0	2
X- 96	97.8	0.0	8.3	0.0	2
X- 97	99.1	80.9	9.0	18.9	6
X- 98	97.9	0.0	9.8	0.0	0
X- 99	78.6	96.0	11.1	91.8	5
X-100	98.2	63.1	8.2	81.4	4

TABLE 41 (CONTINUED)

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
X-101	97.9	0.3	9.4	6.4	3
X-102	54.1	82.6	12.9	0.0	0
X-103	99.5	0.0	6.5	17.3	3
X-104	68.4	96.1	12.8	44.4	1
X-105	81.4	0.0	9.5	42.5	1
X-106	38.2	97.5	15.0	26.6	4
X-107	99.3	0.4	6.9	0.0	0
X-108	99.7	87.2	9.4	0.0	2
X-109	97.5	53.8	7.6	51.0	4
X-110	100.0	6.0	9.6	0.0	4
X-111	98.3	48.6	9.0	0.0	14
X-112	94.0	0.0	9.4	0.0	0
X-113	85.2	0.0	4.2	0.0	8
X-114	98.5	95.5	6.0	0.0	4
X-115	46.0	94.9	11.3	0.0	0
X-116	99.0	64.3	7.5	59.7	7
X-117	98.8	91.6	9.4	47.3	3
X-118	54.1	98.5	12.9	0.0	0
X-119	23.8	96.0	12.3	78.3	0
X-120	97.5	0.2	5.1	0.0	5

TABLE 41 (CONTINUED)

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
X-121	97.5	78.1	7.6	40.6	5
X-122	96.6	98.0	8.8	31.8	22
X-123	91.4	98.0	11.1	47.5	2
X-124	97.2	0.2	6.3	17.3	6
X-125	97.1	85.3	9.3	66.7	4
X-126	95.6	85.3	9.5	71.9	7
X-127	90.1	96.0	10.3	69.3	1
X-128	67.9	98.1	10.6	17.2	3
X-129	94.6	94.1	10.5	20.6	7
X-130	98.2	34.5	7.8	162.7	13
X-131	73.4	100.0	12.9	13.8	1
X-132	98.9	91.0	9.2	13.4	5
X-133	98.9	66.0	6.6	53.9	2
X-134	99.2	4.3	8.6	20.7	7
X-135	99.3	0.5	10.1	0.0	2

TABLE 42. SUMMARY OF HRISK, ECON, HWAY, AND IND FOR 43 ROMAN CATHOLIC PAROCHIAL SCHOOLS IN CLEVELAND

SCHOOL	HRISK	ECON	HWAY	IND
XI- 1	73.4	12.9	13.8	1
XI- 2	97.8	8.3	35.2	0
XI- 3	54.1	12.9	0.0	0
XI- 4	97.0	10.9	58.8	1
XI- 5	99.3	6.6	98.2	13
XI- 6	68.4	12.8	53.0	1
XI- 7	46.5	11.3	0.0	1
XI- 8	81.7	11.1	62.9	1
XI- 9	98.4	10.0	-	7
XI-10	46.5	11.3	0.0	0
XI-11	44.7	11.2	63.5	0
XI-12	68.4	12.8	8.8	0
XI-13	98.6	7.2	17.3	3
XI-14	84.7	10.6	89.1	1
XI-15	86.4	10.1	18.9	1
XI-16	99.7	9.4	0.0	2
XI-17	78.6	11.1	86.2	2
XI-18	100.0	9.8	34.1	2
XI-19	88.6	9.8	98.6	2
XI-20	90.8	10.2	63.8	3
XI-21	92.4	10.2	44.2	0

TABLE 42 (CONTINUED)

SCHOOL	HRISK	ECON	HWAY	IND
XI-22	96.6	10.3	67.1	6
XI-23	94.6	10.5	20.6	4
XI-24	97.0	9.0	28.2	1
XI-25	99.3	10.1	54.2	6
XI-26	65.2	13.8	13.5	0
XI-27	100.0	8.9	32.7	4
XI-28	93.7	8.7	20.7	7
XI-29	97.5	9.5	57.1	4
XI-30	88.6	10.4	72.1	0
XI-31	95.6	9.9	0.0	3
XI-32	90.3	9.5	63.7	6
XI-33	71.2	11.6	41.3	1
XI-34	98.2	7.8	55.0	1
XI-35	98.4	10.0	19.4	5
XI-36	93.8	5.2	93.6	15
XI-37	88.6	10.9	133.1	1
XI-38	95.6	9.5	102.9	5
XI-39	95.6	9.5	92.4	5
XI-40	99.5	9.9	31.3	1
XI-41	99.6	10.1	0.0	8
XI-42	97.6	9.8	147.4	8
XI-43	95.5	10.2	3.8	3
MEAN	87.2	10.1	46.4	3.1

TABLE 43. SUMMARY OF HRISK, ECON, HWAY AND IND FOR 10 LUTHERAN PAROCHIAL SCHOOLS IN CLEVELAND AND THE SUBURBS

SCHOOL	HRISK	ECON	HWAY	IND
XII- 1	36.7	16.2	-	0
XII- 2	90.1	10.3	50.3	3
XII- 3	49.0	11.9	47.9	0
XII- 4	73.3	12.9	13.8	2
XII- 5	5.4	17.2	0.0	0
XII- 6	31.6	19.3	0.0	0
XII- 7	89.4	12.1	14.2	0
XII- 8	17.7	13.7	0.0	0
XII- 9	35.0	14.1	0.0	0
XII-10	79.6	12.4	51.5	3
MEAN	50.8	14.0	17.8	0.8

TABLE 44. SUMMARY OF HRISK, ECON, HWAY AND IND FOR 21 ELEMENTARY SCHOOLS IN SUBURB I PUBLIC SCHOOL SYSTEM

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
I- 1	7.9	97	14.7	23.2	0
I- 2	30.7	98	12.0	26.3	0
I- 3	9.9	97	16.9	0.0	0
I- 4	8.7	97	13.5	16.7	0
I- 5	8.7	99	13.5	16.7	0
I- 6	50.4	100	14.1	0.0	0
I- 7	5.6	100	13.3	35.8	0
I- 8	8.7	97	13.5	0.0	0
I- 9	5.6	98	13.3	64.6	0
I-10	30.7	95	12.0	16.9	0
I-11	7.9	100	14.7	18.3	1
I-12	10.1	100	14.1	58.7	1
I-13	19.2	99	12.3	10.5	0
I-14	7.9	99	14.7	9.9	0
I-15	36.6	99	12.7	69.4	0
I-16	50.4	99	12.9	72.5	0
I-17	7.9	99	14.7	16.7	0
I-18	9.9	98	16.9	0.0	0
I-19	8.7	99	13.5	27.9	1
I-20	10.1	99	14.1	22.6	0
I-21	50.1	99	12.5	60.7	0
MEAN	18.4	98.5	13.8	27.2	0.14

TABLE 45. SUMMARY OF HRISK, RACIAL, ECON, HWAY AND IND FOR SUBURBS III, V, XIII AND EXURBAN AREA ELEMENTARY PUBLIC SCHOOLS

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
III- 1	9.5	99	13.3	33.7	0
III- 2	9.5	99	13.3	39.2	0
V - 1	58.7	100	13.9	5.7	0
XIII-1	52.3	99	15.7	2.7	0

TABLE 46. SUMMARY OF HRISK, RACIAL, ECON, HWAY AND IND FOR 5 ELEMENTARY SCHOOLS IN SUBURB IV PUBLIC SCHOOL SYSYEM

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
IV- 1	34.0	99	12.0	28.4	0
IV- 2	23.0	99	13.2	22.1	0
IV- 3	48.6	99	11.9	46.7	0
IV- 4	34.0	100	12.0	17.7	0
IV- 5	51.4	15	11.9	25.1	0
MEAN	38.2	82.4	12.2	28.0	0

TABLE 47. SUMMARY OF HRISK, RACIAL, ECON, HWAY AND IND FOR 6 ELEMENTARY SCHOOLS IN SUBURB VI PUBLIC SCHOOL SYSTEM

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
VI- 1	23.5	100	11.9	23.8	0
VI- 2	23.5	100	11.9	15.2	0
VI- 3	52.5	97	12.3	0.0	0
VI- 4	42.5	100	12.4	26.1	0
VI- 5	52.5	74	12.3	67.5	3
	23.5	95	11.9	38.7	2
MEAN	36.3	94.3	12.1	28.6	0.8

TABLE 48. SUMMARY OF HRISK, RACIAL, ECON, HWAY AND IND FOR 11 ELEMENTARY SCHOOLS IN SUBURB VII PUBLIC SCHOOL SYSTEM

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
VII- 1	73.4	100	13.8	12.5	0
VII- 2	66.4	100	11.3	0.0	1
VII- 3	73.4	99	13.8	10.7	0
VII- 4	37.3	99	14.0	21.8	0
VII- 5	17.7	96	13.7	26.6	0
VII- 6	37.3	100	14.0	8.0	0
VII- 7	31.3	100	12.3	17.7	0
VII- 8	37.5	97	11.7	0.0	0
VII- 9	31.3	83	12.3	95.0	0
VII-10	66.4	99	11.2	28.6	0
VII-11	66.4	100	11.2	53.1	0
MEAN	48.9	97.5	12.7	24.9	0.1

TABLE 49. SUMMARY OF HRISK, RACIAL, ECON, HWAY AND IND FOR 11 ELEMENTARY SCHOOLS IN SUBURB VIII PUBLIC SCHOOL SYSTEM

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
VIII- 1	89.4	99	12.1	66.3	2
VIII- 2	47.0	98	17.1	26.9	0
VIII- 3	84.7	99	14.4	66.8	0
VIII- 4	77.4	99	17.0	69.6	0
VIII- 5	99.0	98	12.9	36.2	2
VIII- 6	97.6	99	8.7	0.0	1
VIII- 7	91.9	99	11.7	43.6	4
VIII- 8	77.4	99	17.0	33.3	0
VIII- 9	91.6	98	11.3	41.1	1
VIII-10	84.7	100	14.4	64.3	1
VIII-11	94.0	99	22.7	94.7	1
MEAN	85.0	98.8	14.4	49.3	1.1

TABLE 50. SUMMARY OF HRISK, RACIAL, ECON, HWAY AND IND FOR 11 ELEMENTARY SCHOOLS IN SUBURB IX PUBLIC SCHOOL SYSTEM

SCHOOL	HRISK	RACIAL	ECON	HWAY	IND
IX- 1	73.0	88	16.2	0.0	0
IX- 2	95.8	37	12.5	160.3	1
IX- 3	92.9	78	16.3	13.3	0
IX- 4	94.4	37	15.5	14.9	1
IX- 5	40.1	95	2.2	0.0	1
IX- 6	97.1	89	24.3	21.7	0
IX- 7	65.7	48	17.2	30.9	0
IX- 8	98.0	81	19.1	33.7	0
IX- 9	75.7	83	13.9	72.4	0
IX-10	81.5	87	15.8	86.8	0
IX-11	92.1	87	17.5	85.9	1
MEAN	82.4	73.6	15.5	47.26	0.4

TABLE 51. FREQUENCY DISTRIBUTION OF HOUSING RISK PLOTTED AGAINST THE % OCCURRENCE OF 8.0 + MG LEAD PER 100 GRAMS OF TOOTH TISSUE IN ONLY THOSE CHILDREN WHO HAD LIVED 80 - 100% LIFE SPAN AT THE SAME RESIDENCE. A TOTAL OF 239 SCHOOLS IN THE CLEVELAND PAROCHIAL, AND SUBURBAN SCHOOL SYSTEMS ARE INCLUDED IN THIS TABLE

Range % of 8.0+mgPb	Range of Percent of Housing Units Constructed Before 1950					
	3 - 19	20 - 39	40 - 59	60 - 79	80 - 100%	Total
0	1	10	5	8	42	66
1 - 14	11	8	17	15	35	86
15 - 29	9	5	5	7	38	64
30 - 44	0	1	0	3	12	16
45 - 67	1	0	0	1	5	7
TOTAL	22	24	27	34	132	239

ABLE 52. PERCENT FREQUENCY DISTRIBUTION OF THE HOUSING RISK

Range % of 8.0+mgPb	Range of Percent of Housing Units Constructed Before 1950					
	3 - 19	20 - 39	40 - 59	60 - 79	80 - 100	Total %
0	0.4	4.1	2.1	3.3	17.6	27.6
1 - 14	4.6	3.3	7.1	6.3	14.6	36.0
15 - 29	3.8	2.1	2.1	2.9	16.0	26.8
30 - 44	0.0	0.4	0.0	1.3	5.0	6.7
45 - 67	0.4	0.0	0.0	0.4	2.1	2.9
TOTAL	9.2	10.0	11.3	14.2	55.2	100.0

TABLE 53. FREQUENCY DISTRIBUTION OF THE % OCCURRENCE OF TOOTH LEAD OF 8.0 OR MORE MG LEAD PER 100 GRAMS OF TISSUE AND THE VEHICLE TRAFFIC OF 223 SCHOOLS IN THE CLEVELAND PUBLIC, PAROCHIAL, AND SUBURBAN SCHOOL SYSTEMS. THE CHILDREN INCLUDED IN THE TABLE WERE ONLY THOSE WHO HAD LIVED 80 TO 100% OF THEIR LIFE IN THE SAME RESIDENCE WHERE LIVING WHEN THE TOOTH WAS SHED. THE "0" COLUMN REPRESENTS SCHOOL TRAFFIC AREA WHICH DID NOT CONTAIN AN INTERSECTION IN THE LIST OF 1,050 HIGHEST TRAFFIC INTERSECTIONS IN CUYAHOGA COUNTY

8.0 + mg Pb	Number of Vehicles in Thousands						
	0	1 - 34	35 - 69	70 - 99	100 - 139	140+	Total
0	9	17	15	5	4	2	52
1 - 14	19	28	25	7	4	1	84
15 - 29	13	21	19	10	0	2	65
30 - 44	3	4	5	2	2	0	16
45+	3	1	1	0	1	0	6
TOTAL	47	71	65	24	11	5	223

TABLE 54. PERCENT FREQUENCY DISTRIBUTION OF TABLE 53 ON PERCENT OCCURRENCE OF TOOTH LEAD OF 8.0 OR MORE MG LEAD PER 100 GRAMS OF TISSUE AND VEHICLE TRAFFIC OF 223 SCHOOLS IN THE CLEVELAND PUBLIC, PAROCHIAL AND SUBURBAN SCHOOL SYSTEMS

% 8.0 + mg Pb	Number of Vehicles in Thousands						
	0	1 - 34	35 - 69	70 - 99	100 - 139	140+	Total
0	4.0	7.6	6.7	2.2	1.8	0.9	23.2
1 - 14	8.5	12.6	11.2	3.1	1.8	0.4	37.6
15 - 29	5.8	9.4	8.5	4.5	0.0	0.9	29.1
30 - 44	1.3	1.8	2.2	0.9	0.9	0.0	7.1
45+	1.3	0.4	0.4	0.0	0.4	0.0	2.5
TOTAL %	20.9	31.8	29.0	10.7	4.9	2.2	99.5

TABLE 55. FREQUENCY DISTRIBUTION OF % OCCURRENCE OF 8.0 + MG PB/100 GRAMS OF TOOTH TISSUE AND MEAN INCOME FOR 238 SCHOOLS IN THE CLEVELAND PUBLIC, PAROCHIAL, AND SUBURBAN SCHOOL SYSTEMS. ONLY CHILDREN WHO HAD LIVED 80 TO 100% OF THEIR LIFE AT RESIDENCE WHERE LIVING WHEN TOOTH WAS SHED WERE INCLUDED IN THIS TABLE

% 8.0 + mgPb	Mean Annual Income for School in Thousands.				
	2.2 - 6.5	6.6 - 10.9	11.0 - .4.9	15.4 +	Total %
0	8	37	17	5	67
1 - 14	3	34	24	6	67
15 - 29	1	33	41	6	81
30 - 44	3	8	4	1	16
45+	0	6	1	0	7
Total	15	118	87	18	238

TABLE 56. PERCENT FREQUENCY DISTRIBUTION OF THE ABOVE TABLE

% 8.0 + mgPb	Mean Annual Income for School in Thousands				
	2.2 - 6.5	6.6 - 10.9	11.0 - 14.9	15.4 +	Total %
0	3.4	15.5	7.1	2.1	28.1
1 - 14	1.3	14.3	10.1	2.5	28.2
15 - 29	0.4	13.9	17.2	2.5	34.0
30 - 44	1.3	3.4	1.7	0.4	6.8
45+	0.0	2.5	0.4	0.0	2.9
Total %	6.4	49.6	36.5	7.5	100.0

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TABLE 57. PEARSON COEFFICIENTS OF CORRELATION FOR % OCCURRENCE OF 8.0 OR MORE MG LEAD PER 100 GRAMS OF TOOTH TISSUE, HOUSING RISK (HRSIK), RACIAL (% WHITE), MEAN INCOME (ECON), VEHICLE TRAFFIC (HWAY), AND INDUSTRY (IND) SCORES OF CLEVELAND PUBLIC, CLEVELAND PAROCHIAL, AND SUBURBAN SCHOOLS

	Number Schools	HRISK	RACIAL	ECON	HWAY	IND
8.0 + % LEAD						
Cleveland	126	.0569 S = .263	- .0140 S = .449	.0637 S = .240	.0876 S = .165	.1487 S = .048
Parochial	46	- .0471 S = .378	- -	.1793 S = .117	- .1486 S = .162	- .1070 S = .240
Suburbs	67	.0712 S = .284	- .0628 S = .307	- .0530 S = .335	.1248 S = .157	.0079 S = .475
HRISK						
Cleveland	126	-	- .0651 S = .275	- .3806 S = .001	.0200 S = .412	.2107 S = .009
Parochial	46	-	- -	- .8220 S = .001	.4141 S = .002	.5301 S - .001
Suburbs	67	-	- .3183 S = .004	.1304 S = .146	.2743 S = .012	.3079 S = .006
RACIAL						
Cleveland	126	- .0651 S = .275	- -	.3392 S = .001	.1370 S = .103	- .1521 S = .080
Parochial	46	- -	- -	- -	- -	- -
Suburbs	67	- .3183 S = .004	-	- .1053 S = .198	- .2728 S = .013	- .0860 S = .245

TABLE 57. (CONTINUED)

Number Schools	HRISK	RACIAL	ECON	HWAY	IND
ECON					
Cleveland 126	- .3806 .001	.3392 S = .001	- -	.1366 S = .064	- .4124 S = .001
Parochial 46	- .8220 S = .001	- -	- -	- .4134 S = .002	- .5309 S = .001
Suburbs	.1304 S = .146	- .1053 S = .198		- .0239 S = .424	- .2692 S = .014
HWAY					
Cleveland 126	.0200 S = .412	.1370 S = .103	.1366 S = .064	- -	.1345 S = .067
Parochial 46	.4141 S = .002	- -	.4134 S = .002	- -	.3605 S = .007
Suburbs 67	.2743 S = .012	-.2728 S = .013	-.0239 S = .424	- -	.2150 S = .040
IND					
Cleveland 126	.2107 S = .009	- .1521 S = .080	- .4124 S = .001	.1345 S = .067	- -
Parochial 46	.5301 S = .001	- -	- .5309 S = .001	.3605 S = .007	- -
Suburbs 67	.3079 S = .006	.0860 S = .245	- .2692 S = .014	.2150 S = .040	- -

TABLE 58. SPEARMAN CORRELATIONS FOR % OCCURRENCE OF 8.0 OR MORE MG LEAD PER 100 GRAMS OF TOOTH TISSUE, HOUSING RISK (HRISK), % WHITE (RACIAL), MEAN INCOME (ECON), VEHICLE TRAFFIC (HWAY), AND INDUSTRY (IND) SCORES OF CLEVELAND, PAROCHIAL, AND SUBURBAN SCHOOLS

Number Schools		HRISK	RACIAL	ECON	HWAY	IND
8.0 + % LEAD						
Cleveland	126	.0336 S = .355	.0473* .332	.0931 S = .151	.1220 S = .087	.0477 S = .298
Parochial	46	- .1662 S = .135	-	.2420 S = .053	- .0751 S = .310	- .0572 S = .353
Suburbs	67	.0021 S = .493	- .0938 .225	- .0105 S = .466	.1088 S = .190	.0829 S = .252
HRISK						
Cleveland	126	-	- .2598* S = .008	- .5174 S = .001	- .1198 S = .091	.3649 S = .001
Parochial	46	-	-	- .8606 S = .001	.3614 S = .007	.6916 S = .001
Suburbs	67	-	- .2205 S = .037	-.0077 S = .475	.1955 S = .056	.2909 S = .008
RACIAL						
*Cleveland	87	- .2598 S = .008	- -	.4452* S = .001	.1265*	- .1931 S = .037
Parochial	46	-	-	-	-	-
Suburbs	67	- .2205 S = .037	- -	- .1551 S = .105	- .1004 S = .209	- .0518 S = .338

TABLE 58 (CONTINUED)

Number Schools		HRISK	RACIAL	ECON	HWAY	IND
ECON						
Cleveland	126	- .5174 S = .001	.4452* S = .001	- -	.1741 S = .026	- .4317 S = .001
Parochial	46	- .8606 S = .001	- -	- -	- .4493 S = .001	- .6580 S = .001
Suburbs	67	- .0077 S = .475	- .1551 S = .105	- -	- .0800 S = .260	- .2837 S = .010
HWAY						
Cleveland	126	- .1198 S = .091	.1265* S = .122	.1741 S = .026	- -	.1645 S = .033
Parochial	46	- .3614 S = .007	- -	- .4493 S = .001	- -	.3689 S = .006
Suburbs	67	.1955 S = .056	- .1004 S = 209	- .080 S = .260	- -	.1807 S = .072
IND						
Cleveland	126	.3649 S = .001	- .1931 S = .037	- .4317 S = .001	.1645 S = .033	- -
Parochial	46	.6916 S = .001	- -	- .6580 S = .001	.3689 S = .006	- -
Suburbs	67	.2909 S = .008	- .0518 S = .338	- .2837 S = .010	.1807 S = .072	- -

* The asterisk indicates coefficients of correlation on only 87 Cleveland public schools instead of 126 schools used for other coefficients for the Cleveland public school system.

TABLE 59. PERCENT OCCURRENCE OF 8.0 MG OR MORE OF TOOTH LEAD PER 100G TOOTH TISSUE IN RELATION TO HRISK, RACIAL, ECON, HWAY, IND FOR THE CLEVELAND PUBLIC AND PAROCHIAL SCHOOLS. THE COLUMN "NO" REPRESENTS THE NUMBER OF CHILDREN WHOSE TEETH WERE ANALYZED FOR LEAD. THE COLUMN "8.0 MG" REPRESENTS THE PERCENT OCCURRENCE OF TEETH CONTAINING 8.0 OR MORE MG PB/100G OF TOOTH TISSUE. SCHOOLS ARE ARRANGED ACCORDING TO AIR COLLECTING STATIONS

SCHOOL	NO.	%8.0mg+	HRISK	RACIAL	ECON	HWAY	IND
Air Station 1							
X- 8	28	3.6	85	0	4.2	0.0	2
X- 75	8	12.5	3	0	8.3	0.0	1
X-116	48	14.6	99	64	7.5	59.7	7
XI- 43	12	25.0	96	-	10.2	3.8	3
Air Station 2							
X- 1	-	-	89	45	10.9	116.0	6
X- 2	29	10.3	89	59	10.9	134.5	1
X- 3	49	28.6	89	4	10.9	117.0	6
X- 17	21	14.3	97	1	9.4	39.1	2
X- 59	35	14.3	76	3	16.9	120.4	1
X- 71	46	13.0	94	0	8.9	53.9	1
X- 92	12	0	96	1	10.4	61.7	0
X- 93	70	22.9	92	0	8.6	100.8	0
X-133	12	16.7	99	66	6.6	53.9	2
XI- 19	2	0	89	-	9.8	98.6	2
XI- 25	6	16.7	99	-	10.1	54.2	6

TABLE 59 (CONTINUED)

SCHOOL	NO.	%8.0mg	HRISK	RACIAL	ECON	HWAY	IND
XI- 30	7	14.3	89	-	10.4	72.1	0
XI- 37	21	0	89	-	10.9	133.1	1
Air Station 3							
X- 35	96	14.6	82	97	9.4	29.0	1
X- 41	22	18.2	84	91	10.3	82.7	1
X- 86	30	16.7	84	98	11.1	100.8	1
X-108	64	20.3	100	87	9.4	0.0	2
XI- 16	9	44.4	100	-	9.4	0.0	2
Air Station 4							
X- 16	55	9.1	99	0	7.3	35.5	4
X- 24	9	0	89	0	5.4	57.7	3
X- 32	25	32.0	98	0	5.3	0.0	12
X- 52	21	0	100	1	6.6	0.0	6
X- 64	-	-	89	0	5.4	0.0	1
X- 68	28	10.7	97	0	6.6	0.0	2
X- 82	44	18.2	97	1	6.6	0.0	5
X- 94	20	10.0	99	72	9.5	76.6	3
X-103	-	-	100	0	6.5	17.3	3
X-120	35	5.7	98	0	5.1	0.0	5
X-124	40	27.5	97	0	6.3	17.3	6
XI- 13	16	6.3	99	-	7.2	17.3	3

TABLE 59 (CONTINUED)

SCHOOL	NO.	%8.0mg+	HRISK	RACIAL	ECON	HWAY	IN
Air Station 5							
X- 48	40	0	98	99	9.4	0.0	1
X- 58	51	5.9	98	100	9.8	21.2	3
X- 87	-	-	99	29	9.4	118.4	5
X- 91	36	27.8	97	99	9.3	40.3	2
X-117	42	7.1	99	92	9.4	47.3	3
X-134	52	17.3	99	4	8.6	20.7	7
XI- 27	13	0	100	-	8.9	32.7	4
XI- 28	10	0	94	-	8.7	20.7	7
XI- 42	14	7.1	98	-	9.8	147.4	8
Air Station 6							
X- 40	97	15.5	98	4	9.5	57.0	6
X- 45	42	2.4	72	76	10.3	16.0	4
X- 61	43	18.6	91	30	10.2	38.0	1
X- 85	30	20.0	77	90	10.3	55.3	3
X-129	57	24.6	95	94	10.5	20.6	7
XI- 21	9	11.1	92	-	10.2	44.2	0
XI- 22	18	5.6	97	-	10.3	67.1	6
XI- 23	16	18.8	95	-	10.5	20.6	4
XI- 29	7	14.3	98	-	9.5	57.1	4

TABLE 59 (CONTINUED)

SCHOOL	NO.	%8.0mg+	HRISK	RACIAL	ECON	HWAY	IND
Air Station 7							
X- 47	15	33.3	85	94	10.6	123.0	3
X- 56	86	26.7	99	99	11.0	93.2	1
X- 72	58	6.9	90	94	10.3	173.9	2
X- 73	62	19.4	97	96	9.3	107.9	6
X- 78	43	9.3	82	96	12.1	160.0	1
X-125	56	14.3	97	85	9.3	66.7	4
X-127	-	-	90	96	10.3	69.3	1
XI- 14	30	13.3	85	-	10.6	89.1	1
XI- 34	49	14.3	98	-	7.8	55.1	1
XI- 38	11	9.1	96	-	9.5	102.9	5
Air Station 8							
X- 34	31	25.8	83	98	10.7	88.6	3
X- 81	31	22.6	71	99	12.6	24.8	1
XI- 4	58	17.2	97	-	10.9	58.8	1
XI- 15	23	8.7	86	-	10.1	18.9	1
Air Station 9							
X- 11	59	16.9	100	0	-	22.6	2
X- 13	36	11.1	97	91	9.3	64.4	3
X- 25	42	11.9	63	0	5.3	22.6	3
X-114	50	10.0	99	96	6.0	0.0	4
X-132	29	13.8	99	91	9.2	13.4	5
X-135	17	5.9	99	1	10.1	0.0	2
XI- 31	10	10.0	96	-	9.9	0.0	3

TABLE 59 (CONTINUED)

SCHOOL	NO.	%8.0mg+	HRISK	RACIAL	ECON	HWAY	IND
Air Station 10							
X- 21	22	31.8	98	74	10.0	0.0	16
X- 39	19	5.3	98	1	5.1	66.3	15
X- 42	23	4.3	100	42	10.1	0.0	8
X- 63	51	17.6	100	58	9.6	0.0	7
X- 67	27	11.1	99	1	5.9	0.0	12
X-111	13	15.4	98	49	9.0	0.0	14
XI- 41	11	18.2	100	-	10.1	0.0	8
Air Station 12							
X- 50	53	11.3	54	98	12.9	52.6	0
X-118	36	13.9	54	99	12.9	0.0	0
Air Station 13							
X- 5	45	11.1	90	100	10.8	0.0	1
XI- 18	25	0	100	-	9.8	34.1	2
XI- 40	6	0	100	-	9.9	31.3	1
Air Station 14							
X- 7	24	20.8	98	0	12.6	13.5	0
X- 14	40	0	45	1	11.1	26.8	0
X- 43	22	18.2	79	1	11.1	13.5	0
X- 55	-	-	65	0	13.8	26.5	0
X- 90	39	23.1	68	1	10.3	13.6	0
XI- 2	5	0	98	-	8.3	35.2	0
XI- 26	14	0	65	-	13.8	13.5	0

TABLE 59 (CONTINUED)

SCHOOL	NO.	%8.0 mg+	HRISK	RACIAL	ECON	HWAY	IND
Air Station 15							
X-19	58	14.0	97	86	9.1	51.0	3
X-62	17	29.4	22	47	4.6	133.4	14
X-70	48	4.2	98	70	7.8	81.1	10
X-97	76	14.5	99	81	9.0	18.9	6
X-100	36	13.9	98	63	8.2	81.4	4
X-109	19	5.3	98	54	7.6	51.0	4
X-121	73	19.2	98	78	7.6	40.6	5
X-130	9	0	98	35	7.8	162.7	13
XI-1	24	20.8	73	-	12.9	13.8	1
XI-9	12	8.3	98	-	10.0	-	7
XI-36	3	0	94	-	5.2	93.6	15
XI-39	11	0	96	-	9.5	92.4	5
Air Station 16							
X-9	94	16.0	98	99	10.2	58.0	1
X-76	59	8.5	82	97	11.1	39.7	1
XI-8	27	14.8	82	-	11.1	62.9	1

TABLE 59 (CONTINUED)

SCHOOL	NO.	%8.0mg+	HRISK	RACIAL	ECON	HWAY	IND
ir Station 17							
X- 26	30	10.0	94	0	9.4	0.0	0
X- 29	17	5.9	97	0	7.2	0.0	1
X- 33	21	4.8	94	0	7.6	0.0	0
X- 37	16	31.3	99	0	7.9	0.0	0
X- 69	28	14.3	100	1	8.2	0.0	0
X- 77	14	7.1	97	1	7.2	0.0	0
X- 83	-	-	99	1	6.9	0.0	0
X- 88	38	7.9	98	0	9.1	0.0	2
X- 98	42	9.5	98	0	9.8	0.0	0
X-107	12	25.0	99	0	6.9	0.0	0
X-110	24	16.7	100	6	9.6	0.0	4
X-112	22	22.7	94	0	9.4	0.0	0
ir Station 18							
X- 4	49	6.1	93	0	9.1	71.9	1
X- 22	86	4.7	97	0	9.5	77.7	1
X- 30	25	36.0	97	1	9.5	30.5	0
X-101	38	7.9	98	0	9.4	6.4	3

TABLE 59 (CONTINUED)

SCHOOL	NO.	%8.0mg	HRISK	RACIAL	ECON	HWAY	IND
Air Station 19							
X-128	48	16.7	68	98	10.6	17.2	3
X-131	39	17.9	73	100	12.9	13.8	1
XI- 35	1	0	98	-	10.0	19.4	5
Air Station 20							
X- 95	33	3.1	72	94	12.1	68.0	2
XI- 17	26	11.5	79	-	11.1	86.2	2

TABLE 60 PEARSON COEFFICIENTS OF CORRELATION OF % OCCURRENCE OF 8.0 MG LEAD PER 100 GRAMS OF TOOTH TISSUE; AND SCORES FOR ATMOSPHERIC PARTICULATE (PT), LEAD (PB), CADMIUM (CD), ANTIMONY (SB), AND SO_2 OF CLEVELAND PUBLIC AND PAROCHIAL SCHOOLS

	8.0+mgPb	Particulate	Air Pb	Air Cd	Air Sb	Air SO_2
% 8.0 mg Pb						
Cleveland	-	- .0520	.1264	-.0102	-.0469	- .0342
	-	N = 88	N = 70	N = 70	N = 64	N = 70
	-	S = .315	S = .149	S = .466	S = .357	S = .389
Parochial	-	- .0119	.1017	.2012	.1944	-.0537
	-	N = 27	N = 21	N = 21	N = 22	N = 25
	-	S = .477	S = .331	S = .191	S = .193	S = .399
PARTICULATE						
Cleveland	- .0520	-	.1635	- .1821	- .0850	.7174
	N = 88	-	N = 70	N = 70	N = 64	N = 70
	S = .315	-	S = .088	S = .066	S = .252	S = .001
Parochial	- .0119	-	- .2707	- .1305	.2641	.7446
	N = 27	-	N = 21	N = 21	N = 22	N = 25
	S = .477	-	S = .118	S = .286	S = .117	S = .001
AIR LEAD						
Cleveland	.1264	.1635	-	- .1016	- .2525	.1063
	N = 70	N = 70	-	N = 70	N = 60	N = 58
	S = .149	S = .088	-	S = .201	S = .026	S = .214
Parochial	.1017	- .2707	-	.1985	- .3856	- .5007
	N = 21	N = 21	-	N = 21	N = 20	N = 20
	S = .331	S = .118	-	S = .194	S = .047	S = .012
AIR CADMIUM						
Cleveland	- .0102	- .1821	- .1016	-	.4571	- .2288
	N = 70	N = 70	N = 70	-	N = 60	N = 58
	S = .466	S = .066	S = .201	-	S = .001	S = .042
Parochial	.2012	- .1305	.1985	-	.0274	- .4331
	N = 21	N = 21	N = 21	-	N = 20	N = 20
	S = .191	S = .286	S = .194	-	S = .454	S = .028

TABLE 60 (CONTINUED)

	8.0+mgPb	Particulate	Air Pb	Air Cd	Air Sb	Air SO_2
AIR ANTIMONY						
Cleveland	- .0469 N = 64 S = .357	- .0850 N = 64 S = .252	- .2525 N = 60 S = .026	.4571 N = 60 S = .001	- - -	.0856 N = 53 S = .271
Parochial	.1944 N = 22 S = .193	.2641 N = 22 S = .117	- .3856 N = 20 S = .047	.0274 N = 20 S = .454	- - -	.4732 N = 21 S = .015
AIR SO_2						
Cleveland	- .0342 N = 70 S = .389	.7174 N = 70 S = .001	.1063 N = 58 S = .214	- .2288 N = 58 S = .042	.0856 N = 53 S = .271	- - -
Parochial	- .0537 N = 25 S = .399	.7446 N = 25 S = .001	- .5007 N = 20 S = .012	- .4331 N = 20 S = .028	.4732 N = 21 S = .015	- - -

TABLE 61 SPEARMAN CORRELATIONS OF THE % OCCURRENCE OF 8.0 + MG LEAD PER 100 GRAMS OF TOOTH TISSUE; AND SCORES FOR ATMOSPHERIC PARTICULATE (PT), LEAD (PB), CADMIUM (CD), ANTIMONY (SB), AND SULFUR DIOXIDE (SO_2) OF CLEVELAND PUBLIC AND PARCHIAL SCHOOLS

8.0 + Pb **IN TEETH**	Particulate	Air Pb	Air Cd	Air Sb	Air SO_2
Cleveland	- .1036 N = 88 S = .168	.0440 N = 70 S = .359	- .0078 N = 70 S = .474	- .0313 N = 63 S = .404	- .0575 N = 70 S = .318
Parochial	.0196 N = 27 S = .461	.0900 N = 21 S = .349	.1030 N = 21 S = .328	.1623 N = 22 S = .235	- .0775 N = 25 S = .356
PARTICULATE					
Cleveland	- - -	.0985 N = 70 S = .209	- .1960 N = 70 S = .052	.1006 N = 63 S = .216	.7229 N = 70 S = .001
Parochial	- - -	- .3089 N = 21 S = .087	- .0382 N = 21 S = .435	.6381 N = 22 S = .001	.7643 N = 25 S = .001
AIR LEAD					
Cleveland	.0985 N = 70 S = .209	- - -	- .0424 N = 70 S = .364	- .5278 N = 59 S = .001	.0752 N = 58 S = .287
Parochial	- .3089 N = 21 S = .087	- - -	.0495 N = 21 S = .416	- .6154 N = 20 S = .002	- .1517 N = 20 S = .262
AIR CADMIUM					
Cleveland	- .1960 N = 70 S = .052	- .0424 N = 70 S = .364	- - -	.7693 N = 59 S = .001	- .2667 N = 58 S = .022
Parochial	- .0382 N = 21 S = .435	.0495 N = 21 S = .416	- - -	.2475 N = 20 S = .146	- .4141 N = 20 S = .035

TABLE 61 (CONTINUED)

	Particulate	Air Pb	Air Cd	Air Sb	Air SO_2
AIR ANTIMONY					
Cleveland	.1006	- .5278	.7693	-	.0041
	N = 63	N = 59	N = 59	-	N = 52
	S = .216	S = .001	S = .001	-	S = .488
Parochial	.6381	- .6154	.2475	-	.3123
	N = 22	N = 20	N = 20	-	N = 21
	S = .001	S = .002	S = .146	-	S = .084
AIR SO_2					
Cleveland	.7229	.0752	- .2667	.0041	-
	N = 70	N = 58	N = 58	N = 52	-
	S = .001	S = .287	S = .022	S = .488	-
Parochial	.7643	-.1517	- .4141	.3123	-
	N = 25	N = 20	N = 20	N = 21	-
	S = .001	S = .262	S = .035	S = .084	-

TABLE 62 TEACHER EVALUATIONS OF CHILDREN IN 25 ELEMENTARY SCHOOLS OF THE CLEVELAND PUBLIC SCHOOL SYSTEM. THE NUMBER OF TEETH ANALYZED AND THE % OCCURRENCE OF TEETH CONTAINING MORE THAN 8.0 MG PB/100G ARE LOCATED IN THE 2ND AND 3RD COLUMNS. THE LAST COLUMN INDICATED PUPILS EVALUATED BY TEACHERS

			Teacher Evaluations of Scores by Schools					
School	No. Children	%8.0+ mg.Pb	Left Hand %	Medication Score	Learning Score	Emotional Score	Physical Score	Pupils Score
X- 9	94	16.0	2.7	0.0	7.3	5.9	2.5	186
X- 14	40	0	11.0	1.8	24.1	13.3	8.1	109
X- 21	22	31.8	8.6	1.6	21.4	13.5	7.1	128
X- 32	25	32.0	7.3	0.6	5.2	9.1	3.2	178
X- 40	97	15.5	10.2	3.0	16.2	13.5	5.0	636
X- 42	23	4.3	7.2	0.7	11.1	10.8	2.5	432
X- 50	53	11.3	11.1	1.2	5.5	4.7	1.6	171
X- 56	86	26.7	16.8	0.9	14.9	14.7	6.6	113
X- 69	28	14.3	8.9	1.2	13.4	11.7	3.7	418
X- 70	48	4.2	6.0	2.5	9.7	10.4	6.7	316
X- 71	46	13.0	20.0	0.0	6.2	11.3	1.4	30

TABLE 62 CONTINUED)

Teacher Evaluations of Scores by Schools

School	No. Children	%8.0+ mg.Pb	Left Hand %	Medication Score	Learning Score	Emotional Score	Physical Score	Pupils Score
X- 73	62	19.4	6.6	0.6	9.1	6.4	2.2	331
X- 81	31	22.6	8.5	3.1	3.5	3.9	1.9	129
X- 88	38	7.9	10.7	2.1	13.3	10.0	3.8	419
X- 91	36	27.8	8.5	2.3	7.0	8.3	2.0	354
X- 93	70	22.9	5.7	0.9	7.4	6.8	1.4	652
X-114	50	10.0	8.9	2.3	9.5	6.0	2.3	213
X-121	73	19.2	6.6	2.9	18.4	16.8	4.2	244
X-124	40	27.5	5.5	1.6	14.2	6.1	3.0	128
X-127	-	-	7.3	0.2	5.4	7.9	2.6	402
X-128	48	16.7	14.6	4.7	12.2	7.8	7.4	212
X-129	57	24.6	6.9	1.6	13.3	12.8	5.9	189
X-131	39	17.9	4.7	0.3	4.8	3.5	2.0	317
X-132	29	13.8	8.4	0.4	8.0	4.7	2.7	274
X-134	52	17.3	7.5	0.5	11.6	9.5	2.3	187

TABLE 63 SUMMARY BY AGE OF TEACHER EVALUATION OF 6,480 IN 24 ELEMENTARY PUBLIC SCHOOLS IN THE CLEVELAND PUBLIC SCHOOL SYSTEM

Age	Number of Children	Left Hand		Medication		Learning		Emotional		Physical	
		No.	%	No.	%	Trait+	Index	Trait+	Index	Trait+	Index
5	143	8	5.3%	1	0.65%	57	5.4	64	4.2	21	2.0
6	651	38	5.6%	6	0.88%	378	7.9	460	6.8	144	3.0
7	1,040	93	8.9%	13	1.25%	998	13.7	1,073	10.3	329	4.5
8	1,118	105	9.3%	15	1.33%	726	9.3	1,127	10.0	411	5.2
9	1,057	87	8.3%	11	1.05%	792	10.8	998	9.5	287	3.9
10	918	79	8.1%	15	1.67%	673	10.7	806	9.0	192	3.1
11	861	72	8.3%	15	1.73%	625	10.3	850	9.8	152	2.5
12	692	45	6.5%	8	1.16%	403	8.3	572	8.3	122	3.6
TOTAL	6,480	527	8.1%	84	1.13%	4,652	10.2	5,950	9.2	1,658	3.6

TABLE 64 PEARSON COEFFICIENTS OF CORRELATION OF THE PERCENT OCCURRENCE OF 8.0 + MG LEAD PER 100 GRAMS OF TOOTH TISSUE; SCHOOL SCORES FOR PRE 1950 HOUSING (HRISK), % WHITE (RACIAL), MEAN INCOME (ECON), AND INDUSTRY (IND) SCORES; AND TEACHER EVALUATIONS FOR ELEMENTARY SCHOOLS IN THE CLEVELAND PUBLIC SCHOOL SYSTEM

	8.0+mgPb	HRISK	RACIAL	ECON	HWAY	IND
% Left Handed	- .3134 N = 25 S = .064	- .2008 N = 25 S = .168	- .0621 N = 19 S = .400	.1623 N = 25 S = .219	.1455 N = 25 S = .244	-.2497 N = 25 S = .114
Medication	- .3408 N = 23 S = .056	- .2071 N = 23 S = .172	.0482 N = 18 S = .425	.0003 N = 23 S = .499	.0166 N = 23 S = .470	- .0313 N = 23 S = .444
Physical	- .2300 N = 25 S = .134	- .1799 N = 25 S = .195	- .2487 N = 19 S = .152	.0733 N = 25 S = .364	.0285 N = 25 S = .446	.3119 N = 25 S = .065
Emotional	- .2304 N = 25 S = .134	.2404 N = 25 S = .124	- .4778 N = 19 S = .019	- .1766 N = 25 S = .199	.1253 N = 25 S = .275	.2814 N = 25 S = .086
Learning	- .1615 N = 25 S = .220	- .0322 N = 25 S = .439	- .5556 N = 19 S = .007	- .0943 N = 25 S = .327	- .1437 N = 25 S = .247	.2737 N = 25 S = .093

TABLE 65 SPEARMANS CORRELATIONS OF THE PERCENT OCCURRENCE OF 8.0 + MG LEAD PER 100 GRAMS OF TOOTH TISSUE; SCHOOL SCORES FOR PRE 1950 HOUSING (HRISK), % WHITE (RACIAL), MEAN INCOME (ECON), AND INDUSTRY (IND) SCORES; AND TEACHER EVALUATIONS FOR 25 ELEMENTARY SCHOOLS IN THE CLEVELAND PUBLIC SCHOOL SYSTEM

	8.0mgPb	HRISK	RACIAL	ECON	HWAY	IND
% Left Handed	- .3132 N = 25 S = .064	- .0539 N = 25 S = .399	- .1429 N = 19 S = .280	.2245 N = 25 S = .140	- .0354 N = 25 S = .433	- .2763 N = 25 S = .091
Medication	- .4246 N = 23 S = .022	- .1724 N = 23 S = .216	.0021 N = 18 S = .497	- .0461 N = 23 S = .417	.1541 N = 23 S = .241	.0142 N = 23 S = .474
Physical	- .1554 N = 25 S = .229	.1758 N = 25 S = .200	- .4757 N = 19 S = .020	.0073 N = 25 S = .486	- .0930 N = 25 S = .329	.3453 N = 25 S = .045
Emotional	- .1870 N = 25 S.= .185	.3146 N = 25 S = .063	- .5697 N = 19 S = .005	- .1557 N = 25 S = .229	.1120 N = 25 S = .297	.2476 N = 25 S = .116
Learning	- .1391 N = 25 S = .254	.3194 N = 25 S = .060	- .6832 N = 19 S = .001	- .1459 N = 25 S = .243	- .0964 N = 25 S = .326	.2323 N = 25 S = .132

TABLE 66 TEACHER EVALUATIONS IN 6 SCHOOLS CONTAINING LESS THAN 5% WHITE OR 95% BLACK CHILDREN AND 8 SCHOOLS CONTAINING 96 TO 100% WHITE CHILDREN. THESE SCHOOLS WERE IN THE CLEVELAND PUBLIC SCHOOL SYSTEM

School	Racial	Tooth Pb %8.0+mgPb	% Left handed	% Medication	Learning Score	Emotional Score	Physical Score
X-134	4%	17.3	7.5	0.5	11.6	9.6	2.3
X- 32	0%	32.0	7.3	0.6	5.2	9.1	3.2
X- 88	0%	7.9	10.7	2.1	13.3	10.0	3.8
X- 93	0%	22.9	5.7	0.9	7.4	6.8	1.4
X-124	0%	27.5	5.5	1.6	14.2	6.1	3.0
X- 40	4%	15.5	10.2	3.0	16.2	13.5	5.0
MEAN:	1.3%	20.5	7.8	1.5	11.3	9.2	3.1
X- 9	99%	16.0	2.7	0.0	7.3	5.9	2.5
X- 81	99%	22.6	8.5	3.1	3.5	3.9	1.9
X- 91	99%	27.8	8.5	2.3	7.0	8.3	2.0
X-131	100%	17.9	4.7	0.3	4.8	3.5	2.0
X- 56	99%	26.7	16.8	0.9	14.9	14.7	6.6
X- 73	96%	19.4	6.6	0.6	9.1	6.4	2.2
X-128	98%	16.7	14.6	4.7	12.2	7.8	7.4
X-127	96%	-	7.3	0.2	5.4	7.9	2.6
MEAN	98.3%	21.4	8.7	1.6	8.0	7.3	3.4

TABLE 67 PEARSON COEFFICIENTS OF CORRELATION OF THE 5 SCORES OF EVALUATIONS OF LEFT HANDED (% LEFT), USE OF MEDICATION (% MED); AND THE PHYSICAL, EMOTIONAL, AND LEARNING SCORES OF SYMPTOMS OF LEAD POISONING FOR 25 ELEMENTARY SCHOOLS IN THE CLEVELAND PUBLIC SCHOOL SYSTEM. A TOTAL OF 6,480 CHILDREN WERE INCLUDED IN THE TEACHERS EVALUATIONS OF THE SYMPTOMS OF LEAD TOXICITY IN CHILDREN ATTENDING THESE 25 ELEMENTARY SCHOOLS

	Left Hand	Medication	Physical	Emotional	Learning
% Left Handed	- - -	.3592 N = 23 S = .046	.2418 N = 25 S = .122	.3254 N = 25 S = .056	.1390 N = 25 S = .254
Medication	.3592 N = 23 S = .046	- - -	.4334 N = 23 S = .019	.1886 N = 23 S = .194	.2659 N = 23 S = .110
Physical	.2418 N = 25 S = .122	.4334 N = 23 S = .019	- - -	.6211 N = 25 S = .001	.7521 N = 25 S = .001
Emotional	.3254 N = 25 S = .056	.1886 N = 23 S = .194	.6211 N = 25 S = .001	- - -	.7458 N = 25 S = .001
Learning	.1390 N = 25 S = .254	.2659 N = 23 S = .110	.7521 N = 25 S = .001	.7458 N = 25 S = .001	- - -

TABLE 68 SPEARMAN CORRELATIONS OF THE FIVE SCORES OF EVALUATIONS OF LEFT HANDED (% LEFT), USE OF MEDICATION (MED), AND THE PHYSICAL, EMOTIONAL, AND LEARNING SCORES OF SYMPTOMS OF LEAD POISONING FOR ELEMENTARY SCHOOLS IN THE CLEVELAND PUBLIC SCHOOL SYSTEM; A TOTAL OF 6,480 CHILDREN WERE INCLUDED IN THE TEACHERS EVALUATIONS OF THE SYMPTOMS OF LEAD TOXICITY IN CHILDREN IN THESE 25 ELEMENTARY SCHOOLS

	% Left Handed	Medication	Physical	Emotional	Learning
% Left Handed	- - -	.3377 N = 23 S = .058	.1895 N = 25 S = .182	.3188 N = 25 S = .060	.2248 N = 25 S = .140
Medication	.3377 N = 23 S = .058	- - -	.3591 N = 23 S = .046	.2410 N = 23 S = .134	.3594 N = 23 S = .046
Physical	.1895 N = 25 S = .182	.3591 N = 23 S = .046	- - -	.6223 N = 25 S = .001	.7517 N = 25 S = .001
Emotional	.3188 N = 25 S = .060	.2410 N = 23 S = .134	.6223 N = 25 S = .001	- - -	.7337 N = 25 S = .001
Learning	.2248 N = 25 S = .140	.3594 N = 23 S = .046	.7517 N = 25 S = .001	.7337 N = 25 S = .001	- - -

TABLE 69. PEARSON COEFFICIENTS OF CORRELATIONS OF 8.0 + MG LEAD PER 100 GRAMS OF TOOTH TISSUE, OF TEACHER EVALUATIONS IN 25 CLEVELAND PUBLIC SCHOOLS AND ATMOSPHERIC SCORES FOR THE AIR STATIONS IN WHICH THE SCHOOLS ARE LOCATED. THE PERCENT OF LEFT HANDED AND MEDICATION, AND THE SCORES OF PHYSICAL, EMOTIONAL, AND LEARNING SYMPTOMS OF LEAD POISONING WERE ITEMS INCLUDED IN THE EVALUATIONS BY TEACHERS

	8+Tooth Pb	Particulate	Air Pb	Air Cd	Air Sb	Air SO_2
% Left Handed	-.3134 N = 25 S = .064	-.1393 N = 25 S = .253	-.0479 N = 19 S = .423	-.2919 N = 19 S = .113	-.1192 N = 18 S = .319	-.3994 N = 21 S = .036
Medication	-.3408 N = 23 S = .056	.0203 N = 23 S = .463	.0430 N = 19 S = .431	.2743 N = 19 S = .128	.2707 N = 18 S = .139	-.1682 N = 19 S = .246
Physical	-.2300 N = 25 S = .134	.0569 N = 25 S = .393	.4456 N = 19 S = .028	.2697 N = 19 S = .132	.1696 N = 18 S = .251	-.0005 N = 21 S = .499
Emotional	-.2304 N = 25 S = .134	.1370 N = 25 S = .257	.5485 N = 19 S = .008	.4214 N = 19 S = .036	.2305 N = 18 S = .179	-.1099 N = 21 S = .318
Learning	-.1615 N = 25 S = .220	.2164 N = 25 S = .149	.4779 N = 19 S = .019	.2008 N = 19 S = .205	.0909 N = 18 S = .360	.0734 N = 21 S = .376

TABLE 70 SPEARMAN CORRELATIONS OF 8.0 + MG LEAD PER 100 GRAMS OF TOOTH TISSUE, TEACHER EVALUATIONS IN 25 CLEVELAND PUBLIC SCHOOLS, AND ATMOSPHERIC SCORES FOR THE AIR STATIONS IN WHICH THE SCHOOLS ARE LOCATED. THE PERCENT OF LEFT HANDED (% LEFT) AND MEDICATION (MED), AND THE SCORES OF PHYSICAL, EMOTIONAL, AND LEARNING SYMPTOMS OF LEAD POISONING WERE ITEMS INCLUDED IN THE EVALUATIONS BY TEACHERS

	8.0 + mg Tooth	Particulate	Air Pb	Air Cd	Air Sb	Air SO_2
% Left Handed	- .3132 N = 25 S = .064	- .1271 N = 25 S = .272	- .0631 N = 19 S = .399	- .3578 N = 19 S = .066	- .3990 N = 18 S = .050	- .4165 N = 21 S = .030
Medication	- .4246 N = 23 S = .022	- .1181 N = 23 S = .296	- .0481 N = 19 S = .423	- .1682 N = 19 S = .246	- .2260 N = 18 S = .184	- .2152 N = 19 S = .188
Physical	- .1554 N = 25 S = .229	.1692 N = 25 S = .209	.4785 N = 19 S = .019	.2113 N = 19 S = .193	- .0187 N = 18 S = .471	.3050 N = 21 S = .089
Emotional	- .1870 N = 25 S = .185	.0243 N = 25 S = .454	.5884 N = 19 S = .004	.4636 N = 19 S = .023	.0151 N = 18 S = .476	- .0525 N = 21 S = .411
Learning	-.1391 N = 25 S = .254	.1908 N = 25 S = .180	.4313 N = 19 S = .033	.2201 N = 19 S = .183	- .0996 N = 18 S = .347	.1408 N = 21 S = .271

TABLE 71 TEACHER EVALUATIONS OF 11,400 CHILDREN IN SEVEN SUBURBS OF CLEVELAND.

Suburb	Number of Children	Left Hand		Medication		Learning		Emotional		Physical	
		No.	%	No.	%	No.	Index	No.	Index	No.	Index
1.	4,480	449	10.2	89	2.1	2,281	7.1	3,137	7.2	994	3.3
2.	1,955	153	7.8	34	1.7	1,169	8.5	1,761	9.0	487	3.6
3.	1,447	132	11.0	15	1.4	828	10.0	1,296	10.8	269	3.6
4.	316	28	8.9	6	1.9	141	6.4	210	6.6	46	2.1
5.	1,656	139	8.4	36	2.2	765	6.6	1,240	7.5	309	2.7
6.	1,108	104	8.7	32	2.1	584	7.3	837	8.3	291	2.6
7.	438	39	8.9	13	3.0	191	6.2	343	7.8	138	4.5
TOTAL	11,400	1,044		225		5,959		8,824		2,534	

"No." represents the number of children left handed and known to be receiving medication and the number of traits present as reported by the teachers.

TABLE 72 SUMMARY BY AGE OF TEACHER EVALUATIONS OF 4,497 CHILDREN IN NINE ELEMENTARY SCHOOL OF ONE SUBURB

Age	Number of Children	Left Hand		Medication		Learning		Emotional		Physical	
		No.	%	No.	%	No.	%	No.	%	No.	%
5	142	5	3.5	0	0.0	67	6.7	142	10.0	62	6.2
6	534	51	9.6	9	1.7	201	5.4	378	7.1	137	3.7
7	568	48	8.5	11	1.9	335	8.4	486	8.6	179	3.2
8	639	67	10.5	11	1.7	409	9.2	510	8.0	154	3.5
9	683	59	8.6	19	2.8	279	5.8	487	7.1	117	2.4
10	735	74	10.1	12	1.6	391	7.6	459	6.2	120	2.3
11	658	81	12.3	15	2.3	313	6.8	373	5.7	99	2.1
12	538	64	11.9	12	2.2	287	7.6	312	5.8	126	3.3
TOTAL	4,497	449		89		2,281		3,137		994	

"No." represents the number of children left handed and known to be receiving medication and the number of traits present as reported by the teachers.